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The late glacial Federmesser site of Borneck-Ost, Germany

a technological re-analysis of the lithic assemblage using a *chaîne opératoire* approach

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Abstract

The present study is a technological re-analysis of the late-glacial extant collection from Borneck-Ost, Ahrensburgian tunnel valley, Germany. The site is attributed to the Federmesser culture (12 000 – 10 800 cal BC), and has figured in the Late Glacial research canon because remains of a "spectacle-shaped" tent were identified there (Rust 1958). The focus of this study is to determine if the previous interpretation of Borneck-Ost is reliable according to modern archaeological practice. Using a *chaîne opératoire* as the methodological framework, the lithic material from the site has been technologically re-analysed. Refitting has supplied additional information. A source-critical perspective on the re-analysis of extant collections is imperative, since these were studied according to a different analytical paradigm. In addition to the procedural aspect of the re-analysis, new information on knapping techniques is discussed. New and revised results and interpretations for the Federmesser site Borneck-Ost will be presented.

Preface

Part and parcel of this project is the lithic analysis carried out during my exchange to Schleswig in the fall of 2012. This would not have been possible without the initiative of my advisor, Dr. Sheila D. Coulson, whose encouragement over the past years has been greatly appreciated. My second advisor, PD Dr. Berit Valentin Eriksen, is thanked for her useful feedback during my stay at Schloss Gottorf. Dr. Mara-Julia Weber I thank for her help, and for introducing me to the Swabian lifestyle in the opposite part of Germany. Information provided by Dr. Ingo Clausen, Dr. Sönke Hartz and Dr. Ingrid Ulbricht was much appreciated. I would also like to thank Felix, Inga, Kerstin, Ria and Suzana for making me feel at home in the office, and Sonja B. Grimm for providing me access to a chapter of her forthcoming doctoral thesis.

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— Julia Kristine Kotthaus

CHAPTER 1

Introduction

1.1 Introduction

The present study is a technological re-analysis of the late glacial Ahrensburgian tunnel valley site of Borneck-Ost, Germany (see figure 1). Following a *chaîne opératoire* approach, the lithic material from the site will be re-investigated. In order to determine if the lithic assemblage is reliable according to modern archaeological practice, a source-critical perspective is imperative, since the site was excavated and analysed more than sixty years ago, according to a different analytical paradigm.

Borneck-Ost, which was dug and analysed by Alfred Rust (1958), has been attributed to the Federmesser (12 000 – 10 800 cal BC (Riede et al. 2010:298)). The Federmesser is a less-well understood period during the Late Glacial, and eclipsed by more prominent periods such as the Hamburgian or Bromme (see table 1 and e.g. (Brinch Petersen 2009:100); (Riede et al. 2010:311)). The site has figured in the research canon because remains of a "spectacle-shaped" tent were identified there (see cover illustration and (Rust 1958:46)).

The Ahrensburgian tunnel valley, located at the northern periphery of Hamburg, Germany (see figure 1), is well-known for its many late-glacial archaeological sites. Due to the extent of excavated assemblages, as well as their excellent state of preservation, these sites were central to the formation of the cultural chronology for the Late Glacial (e.g. (Tromnau 1975); (Bokelmann 1991); (Grimm and Weber 2008:297); (Brinch Petersen 2009); (Riede et al. 2010)). The discovery of the Ahrensburgian tunnel valley sites helped challenge the prevailing consensus that human groups had not travelled as far north as beyond the borders of the Last Glacial ice margin. Many of the sites have since become typological cornerstones (Tromnau 1975:11-13).

Over the past decades, unfortunately, only very few stratified finds and sites have been added to the research material, and the tunnel valley sites have not been extensively re-

Table 1: Overview of Late Glacial archaeological cultures on the north-western European plain (after Riede et al. 2010:298, fig 1; Hartz 2012:390- 391, fig. 1).

Archaeological culture	Hamburgian	Federmesser	Bromme	Ahrensburgian
Time frame	12 700-12 000 BC	12 000-10 800 BC	11 400-10500 BC	10 800-9700 BC
Pollen zone in Schleswig-Holstein	Meiendorf; Oldest Dryas	Bölling/Alleröd	Alleröd; Younger Dryas	Alleröd; Younger Dryas
Knapping technique	direct soft	direct hard and/or soft	direct hard	direct hard; direct soft

investigated since they were first excavated and analysed. The majority of these sites were discovered and excavated between the 1930s and early 1950s by Alfred Rust, a self-taught archaeologist from Hamburg and *primus motor* in Late Glacial research in the area. Rust is part of the culture-historical tradition of autodidact researchers whose excavations have contributed with large bodies of material, and which are still subject for research (Roveland 2000).

While surveys and archaeological prospections have been funded, economical reasons are, as always, an obstacle for large scale excavations and acquisition of new material. Surface finds by amateur and volunteer archaeologists and collectors constitute the largest additions to the research catalogue. In light of this situation, it is especially relevant to consider re-analyses of extant collections as meaningful resources. Extant collections are bodies of material which have been analysed before. Their re-analysis requires a source-critical approach. Much of the available information regarding aspects of the Late Glacial is rooted within the traditionalist framework which it was first examined in, and, in many cases, cannot be considered reliable according to current research standards. Still, the available excavated material should by no means be forgotten as a source to increase knowledge about the Late Glacial.

With a few recent exceptions (e.g., (Weber 2012)), none of the previously published Ahrensburgian tunnel valley sites have been re-examined using a *chaîne opératoire* approach. New material, however, has been approached in this manner since the 1980s, and the method of refitting especially has contributed with many interesting results in this region (e.g. (Hartz 1987); (Clausen and Hartz 1988); (Clausen 1997); (Weber 2012)).

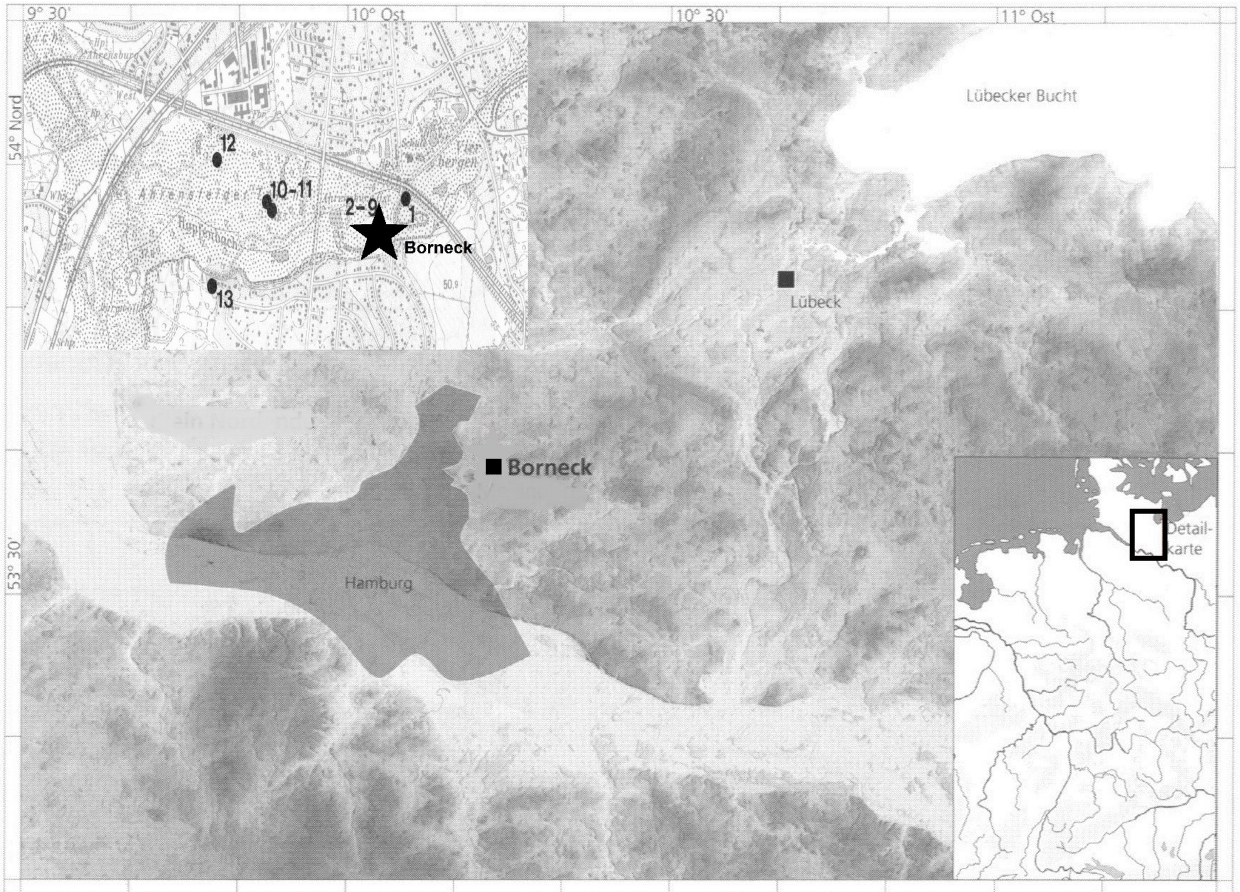


Figure 1: Location of site in northern Germany and overview of Ahrensburgian tunnel valley sites (after Riede et al. 2010:299, fig. 2, insert after Tromnau 1975:map 1).

1.2 The focus of this study

During the excavation of Borneck-Ost, a large stone cluster spanning over 60 m^2 was uncovered. In the original publication, this stone structure has been interpreted as a construction consisting of two tents, connected with each other through a paved walkway, forming a distinct "spectacle-shape" (see cover illustration) (Rust 1958); (Rust 1972). It has been argued that the tent structure, which will be presented in chapter 3.1, was used repeatedly during winter, and while the largest of these two connected tents provided shelter, the smaller served as storage (Rust 1958:44-61). The site has been classified as Federmesser on the basis of the lithic material. At the time of the excavation, the Federmesser culture was considered to be a Magdalenian sub-group, which accounts for why the double-tent is commonly referred to as the "Magdalenian tent".

As they say in Norwegian, *kjært barn har mange navn*, and the structure at Borneck-Ost has figured in the literature under a wide range of designations and classifications (e.g.

camp, tent, dwelling, habitation). "This nomenclatural confusion merely underlines the fact that, without faunal elements, any functional characterisation of a lithic scatter remains problematic and this is exaggerated by the lack of accepted definitions" (Brinch Petersen 2009:91). Since no direct evidence for the tent other than the stone cluster is preserved, any kind of structure present on the site can now, in any case, be classified as a latent structure (e.g. (Cziesla 1990)). Concerning the presentation and interpretation of the construction, I have chosen to retain the original term *tent* throughout.

The focus of this study is a source-critical approach to an extant collection, which was analysed several decades according to a traditionalist, typological practice. Will a re-analysis according to modern research practice and a focus on technological attributes confirm or refute the existing interpretation of Borneck-Ost? Using *chaîne opératoire* as the methodological framework, the lithic material will be re-approached. Following a combined approach of technological and spatial analyses, supplied through results from refitting, it is my intent to present a new interpretation of Borneck-Ost.

1.3 Structure

After the initial presentation of the Federmesser term and culture in chapter two, including research history, chronological and environmental context, some emphasis will be laid on lithic technology. The Borneck-Ost site will be approached and in chapter three, and the methodological framework will be discussed in chapter four. A short presentation of the lithic assemblage, according to the present study, is found in chapter five; a complete catalogue of the lithic material is available upon further request. The technological analysis and refitting, chapters six and seven, form the corpus of the present study. The discussion and interpretation of the results is found in chapter eight. For additional figures and tables, the reader is referred to the appendix.

CHAPTER 2

Federmesser: a framework

Since the Federmesser time period encompasses several oscillations during which drastic climatic and environmental changes took place, a more thorough knowledge of climate, vegetation and fauna during the presence of the Federmesser is necessary. Different chronozones and interstadials can be distinguished from each other stratigraphically, and the refinement of methods has led to the availability of more detailed stratigraphies and improved reconstructions of late-glacial environments (Björk 1996), (Kolstrup 2002). The climatic conditions during the last glacial period, when warmer and colder phases alternated within a relatively brief timespan, will have had an impact on humans and environment alike. How environmental changes can be identified in the archaeological and stratigraphical record, and how closely changes in the archaeological record can be related to external factors, has been the subject for considerable debate (see e.g. (Housley et al. 1997); (Housley, Gamble and Pettitt 2000); (Pettitt et al. 2003)).

In the following pages, a framework for the Federmesser culture will be presented, with regard to research history, chronology, climate and environment as well as technological criteria concerning the lithic material. I will also try to place the Federmesser in the context of other Late Glacial cultures, since the relationships between these are somewhat unclear. Some source critical aspects of working with a previously published assemblage will also be discussed here. This introduction to the Federmesser in general is necessary, since there is still much uncertainty regarding this archaeological period, and the technological analysis carried out in the present study must be seen in relation to this reference material situation.

2.1 Research history

While some of the Late Glacial periods like the Hamburgian in (Weber 2012) have been the subject of extensive re-analysis, the "Federmesser" term, definition and criteria have not been

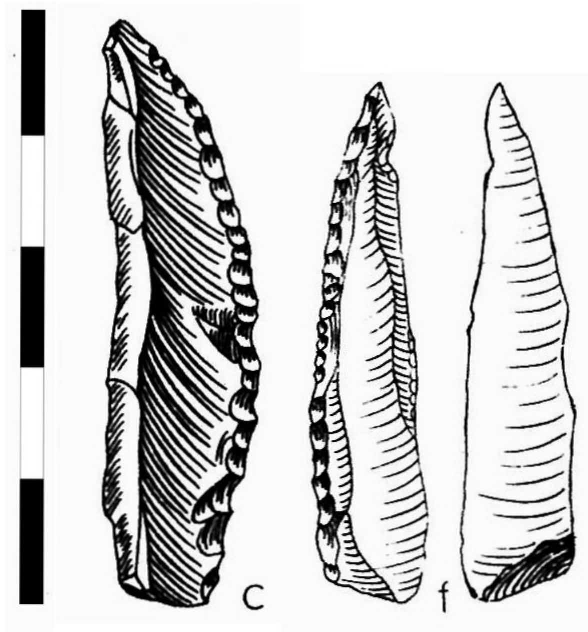


Figure 2: Two exemplary curved back blades *(Federmesser)* from Petersfels (c.) and Westerbeck (f.) (after Schwabedissen 1954:23, fig. 11 c.), f.)).

earnestly re-examined since their conception more than 60 years ago. The term Federmesser derives from the German *Federmesser*, literally meaning feather-(Feder) knife (*Messer*); a portmanteau which describes the eponymous type of long, slender blade with a distinctly curved back and substantially retouched edge (see figure 2) (Schwabedissen 1954:62). Basal modification is generally absent (Schwabedissen 1954:8). The term has been in use for a century (Schmidt 1912:114, in Schwabedissen 1954:8), since its first identification in a range of archaeological assemblages across Europe which at the time were attributed to a Late Magdalenian culture (e.g (Schwabedissen 1954:78, 80); (Taute 1968)).

A first conclusive report about the "Federmesser groups of the North-western European plain" was presented by Hermann Schwabedissen (*Die Federmesser-Gruppen des nordwesteuropäischen Flachlandes*) in 1954 and little has been published on the matter since. Schwabedissen, an expert in lithic typology, established the typology in the inter-war period, around the time of the discovery and first excavations of several of the tunnel valley sites. The Federmesser was further divided into *Rissen, Tjonger* and *Wehlen* groups. This categorisation was mainly based on the typological analysis of artefact concentrations from Rissen, Germany, and Prandinge, Netherlands, as well as some 40 lithic assemblages in Belgium, Germany and the Netherlands (Schwabedissen 1954). Defining elements for the Federmesser are the appearance of different scraper types, crude, diverse burin types, Federmesser blades, Gravettian points, curved back knifes and the absence of awls (Schwabedissen 1954:61-62, 85). In contrast to the material from Magdalenian type sites, organic elements and art appear to be lacking from Federmesser assemblages (ibid.).

The term Federmesser has later been applied as a collective term to encompass several subgroups of similar flint working cultures from different regions, ranging from Poland to Britain, dating to approximately the same time period. These subgroups, e.g. the Azilian, Tarnowian, Tjongerian and Penknife Point groups among others, are often characterised as replacing late Magdalenian characteristics in a process often referred to as *azilianisation*, although the motives and transitional details are yet poorly understood ((Bodu and Valentin 1997); (Thévenin 1999:21); (Valentin 2007); (Terberger, Barton and Street 2009:196). The appearance of Federmesser sites is generally considered to mark a human expansion into the North, although the spatial and temporal distribution still is subject for discussion ((Fagnart 1984); (Burdukiewicz 1996); (Fischer 1996:166); (Newell and Constandse-Westermann 1996); (Fuglestvedt 2007); (Brinch Petersen 2009:100); (Terberger, Barton and Street 2009); (Otte 2012)).

Since the publication of Schwabedissen's monograph, nothing of similar extent or ambition has been published on the Federmesser. Instead, the different aspects which could provide a framework for this period are still under consideration and development, fuelled through advances in analytic methods and the addition of new material. What are integral parts of the Federmesser? Can (re-evaluated) criteria for the Federmesser be established now?

2.2 Federmesser culture: regional diversity, local variability?

> "Unfortunately, no detailed description of the apparently variable knapping techniques of *Federmesser-Gruppen* in the northern part of northern Germany exists."
>
> — *Weber (2012:88)*

I will, in the following, present several criteria and the current status for the Federmesser culture. Since the number of sites associated with the Federmesser has increased significantly in the past decades (see next paragraph), the existing criteria and definitions for the Federmesser should be revised.

Excavated and stratified Federmesser sites are few, and yet to be discovered north of Schleswig-Holstein (Brinch Petersen 2009:101; Terberger et al. 2009:197). Surface finds still constitute the largest artefact category. Important German sites are, among others: Agethorst (Lempke 1996), Ahrenshöft (Hartz 1987), Alt Duvenstedt (Clausen and Hartz 1988); (Clausen 1996), Hasewisch (Hartz 1990), Kettig (Baales and Street 1999); (Baales 2001); (Street, Jöris and Turner 2012), Klein Nordende (Bokelmann, Heinrich and Menke 1983), Schalkholz (Bokelmann 1978) and Schweskau (Breest and Veil 1991). Notable sites abroad Germany are known from Rekem, Belgium (Lauwers 1988); (De Bie, Schurmans and Caspar 2002), the Sandy Flanders region, Belgium (Crombe and Verbruggen 2002); (Crombé et al. 2011), Slotseng, Denmark (Holm 1991), Egtved, Denmark (Fischer 1988), (Holm 1996:44 pp), the Maas valley, Netherlands (Arts 1988); (Deeben 1988); (Rensink 2002). One of the Belgian type sites for Schwabedissen's monograph, Lommel Maatheide in the Campine region, was recently excavated after decades of surface find collecting. The amount of lithic artefacts as well as the preservation of their spatial boundaries allow for some conclusions regarding the placement of the site in the Late Glacial landscape, and complement the earlier obtained picture of this period (De Bie, Van Gils and Deforce 2009).

Magdalenian heritage or influences?

Criteria and artefact groups considered typical for the Magdalenian, e.g. organic bone implements and art, were previously unknown for the Federmesser. Much according to an "absence of evidence/evidence of absence"-argument, the lack of organic elements was included in Schwabedissen's fundamental Federmesser definition (Schwabedissen 1954:80). Since then, several examples of art, which will be mentioned later, have been added to the available Federmesser material, so a revision of absence of organic material in Federmesser assemblages as a characteristic for the Federmesser, is due.

It appears that lithic assemblages from Federmesser-associated sites as well as technological analyses of extant collections and surface finds support theories about a less-strict, less-conform lithic tradition compared to e.g. Magdalenian cultures, albeit with Magdalenian influences intact (e.g. (Bodu 1993:43 pp); (Madsen 1996); (Pelegrin 2000); (Kowalski and Plonka 2009:184)). A general impression is that Federmesser-associated assemblages are less-standardised and display a greater individual variation, which is reflected in the previously mentioned sub-groups. The relationship between the Magdalenian and Federmesser still remains unclear; as are questions relating to change and continuity into the Early Mesolithic (e.g. (Schmider 1987:21); (Schmider 1988); (Arts and Deeben 1987); (Burdukiewicz and Kobusiewicz 1987); (Gob 1988); (De Bie 1999:187)). Is there, however, enough "room" to allow for regional differences within the Federmesser context?

Organic elements and art:

Additionally, organic artefacts have been found in association with Federmesser assemblages in the Central Rhineland ((Bosinski 1975); (Bolus et al. 1988); (Baales and Street 1999:230); Heuschen et al. 2005 in (Terberger, Barton and Street 2009::)193). At Weitsche, Landkreis Lüchow-Danneberg, Lower Saxony, Germany, an amber figurine was discovered, which most likely represents an elk ((Veil and Breest 2002); (Terberger, Barton and Street 2009:193); (Veil et al. 2012)). The analytic results from Weitsche are expected to contribute with additional information in the future. Artistic elements in Federmesser assemblages were unknown from the archaeological record when the period-defining criteria were first established, and are therefore not yet included.

Lithic technology:

As summarised by Weber in the aforementioned quote, no description of Federmesser technological attributes is available at the moment. While additional finds and studies in recent years have contributed with some information, questions concerning lithic technology are far from answered. This situation naturally has an impact on the interpretation of the results from the technological analysis in the present study, as well as it emphasises the clear need for further technological analyses, as suggested by e.g. (Riede et al. 2010:310,312). Recurring observations and challenges are:

- Federmesser elements frequently figure in Havelte group inventories, and a set of shared knapping attributes has been identified (e.g. (Stapert and Krist 1987:83); (Madsen 1992:fig 81); (Holm 1996:48); (Hartz 2012:393-394)). It has been argued that Havelte group artefacts and the Teltwisch site (Tromnau 1975) are representative for a typological transition stage between the Hamburgian and Federmesser. Due to the absence of Havelte finds in the Ahrensburgian tunnel valley and south of the Elbe river, the validity of this argument may be questioned (Gramsch 2004); (Brinch Petersen 2009:98-99).

- Mixed assemblages. In many integral excavated assemblages, near-surface artefacts from younger periods disturb the context in a way that makes it impossible to separate inconspicuous artefacts (Clausen and Hartz 1988:27-28).

- Direct soft stone percussion (resulting in *esquillement de bulbe* ventral bulb scars) and opportunistic use of direct hard hammer ((Bokelmann, Heinrich and Menke 1983:205); (Hartz 1987); (Pelegrin 2000)).

- Extravagant and uneconomic use of flint and raw materials, in strong opposition to a frugal Magdalenian tradition (e.g. (Audouze et al. 1988); (Holm 1996:57); (Valentin 1999:207-209); (Valentin 2007:147-148)).

2.3 Chronological and environmental context

2.3.1 Chronology

For the purpose of the present study, new chronological developments in Late Glacial chronology are mentioned because a need for revision of the current Federmesser chronology is confirmed through a direct example from Borneck. In the original publication, the site is dated into the Allerød (Schütrumpf 1958:16). Schütrumpf's results have been challenged (Usinger 1975:122 pp), and recent ^{14}C dates suggest a radically different chronological assignment, placing the Borneck locations well into the Bølling instead of the Allerød interstadial (Riede et al. 2010:307). The repercussions from this radical re-assignment for the Federmesser are evident, and will hopefully contribute in a general revision of the Federmesser chronological framework. While doubts concerning the integrity of Borneck-Ost are maintained, I argue that they do not render a re-analysis of a local lithic material obsolete.

Late Glacial chronology has been under revision over the past decades. The original nomenclature is to a large degree based on a set of local palynological analyses and sequences, which cannot necessarily be applied to other regions. The use of these local biostratigraphies and terms in a cross-regional perspective has led to confusion, since the same term (e.g. *Bølling*) is often used to describe the biozone as well as the chronozone, according to the previous standard terminology suggested by (Mangerud et al. 1974). The retention of the original terms has become increasingly incompatible with the results gained through modern methods. A correlation with calender years has proven difficult, but the situation is much improved through the now standard application of climatic data (GRIP Greenland ice core stratigraphy) (see also (Wohlfarth 1996); (Björk et al. 1998); (Coope et al. 1998); (Litt and Stebich 1999); (Litt et al. 2001); (De Klerk 2004); (Terberger 2004:206); (Weber 2012)).

Traditionally, the appearance of the Federmesser culture is most commonly placed starting towards the end of the Oldest Dryas, encompassing the Bølling, Middle Dryas and Allerød (a, b, c) late-glacial pollen zones in Schleswig-Holstein (see table 1; (Riede et al. 2010:298, fig. 1)). Although it has been suggested to stop the use of the old nomenclature, these terms still very much figure in the current canon, and, in the case of north-western Germany, the traditional pollen zones can be directly correlated to the now standard Greenlandic ice core $\delta^{18}O$ isotope stages. All fall into Greenland Interstadial (GI-1): Oldest Dryas (GI-1d) and Allerød-Bølling (GI-1c-a) (Terberger 2004); (Terberger 2006); (Grimm and Weber 2008).

2.3.2 Climatic and environmental development

Both humans and animal species will migrate and follow the route of environmental settings favourable to their habitat preferences, on the individual as well the population level. Historically, and until modern times, climate changes are predominantly caused by non-anthropogenic agencies, rendering human populations equally at the mercy of external stress factors (Reitz and Wing 2008:318). A discussion of climatic, faunal and environmental developments during the Late Glacial and individual late-glacial stadials is therefore closely connected with the consequences for human life in terms of hunting, subsistence, technology and all things related. If the archaeological record should answer questions relating to human choices and decisions, a premiss is to accept that during the Late Glacial, non-anthropogenic factors motivate fundamental change, on a much more general and extensive level than changes forced by human agencies (Reitz and Wing 2008:323; 324). While it is felt by some that it is not necessary to present another paraphrase of the ever-valid "adaptations-debate" (Brinch Petersen 2009), a brief overview is imperative, due to the extent and impact of Late Glacial developments.

2.3.3 Fauna present at the time of the Federmesser groups

An increased insight into which species mainly figure during which period exactly, how and where to hunting game migrated, is closely connected with questions regarding subsistence and adaptation (Eriksen 1996); (Larsson 1996); (Vang Petersen and Johansen 1996). If certain types of weapons and hunting techniques, like arrows, not were used during a specific period, this indicates that not all available species may have been effectively hunted (Tromnau 1987); (Eriksen 1996:17-19); (Eriksen 2000d). Evidence for species is available directly through bone material from preserved bones or indirectly from bone artefacts (Bratlund 1996:23), or through a look at pollen zones and environmental factors. The predominant impression has been that the archaeological cultures during the last glacial period can be divided into earlier groups of reindeer hunters (Hamburgian culture, Havelte group) (Bratlund 1996); (Riede 2009), and later groups (Federmesser, Bromme) which were primarily elk hunters (Holm 1996:57); (Riede et al. 2010:309). These species prefer substantially different types of vegetation; in short, reindeer prefer tundra, elk prefer woodlands (see e.g. (Cordy 1991)).

The Borneck location is relevant for these discussions of Federmesser subsistence patterns, since both reindeer and elk bones were excavated, which will be presented later. It is furthermore important for the whole discussion of species survival throughout the Late Glacial (e.g. (Weinstock 2000); (Weinstock 2002); (Terberger 2006:34); (Aaris-Sørensen, Mühldorff and Brinch Petersen 2007); (Terberger, Barton and Street 2009:192)). The presence of reindeer (*rangifer tarandus*) appears to be a constant in Late Glacial fauna. This points towards lasting phases of climatic and environmental stability, but does not exclude species which respond quicker to seasonal changes than others (Currant 1991:48). It has been argued that species with milder climate preferences did not appear instantly in the North after the end of the coldest late-glacial phases (Eriksen 1996:12,13). Mammoths (*mammuthus primigenus*) are slowly becoming extinct after the last glacial maximum. While the presence of ivory and mammoth tusks at different caves in Britain, Southern Scandinavia as well as at Etiolles and Gönnersdorf, shows that mammoths were still present during the Bølling and Allerød, there is no evidence that mammoths were hunted (Evin et al. 1979 and Bosinski 1981 in (Lister 1991:58); (Liljegren and Ekström 1996); (Benecke and Heinrich 2003:29)). It is plausible that faunal variability became increasingly limited towards the north on the north-western European plain (Terberger, Barton and Street 2009:192), which in turn will have had consequences for the selection of species available for hunting.

2.4 Evaluating the available information

Two prevailing source critical aspects must be noted ahead of the re-analysis: is the original documentation itself reliable, and is the Federmesser an archaeological construct or *real*?

Schwabedissen's work has very recently been re-approached and found to not be matching modern standards of archaeological practice. First of all, because Schwabedissen's relatively limited catalogue is mostly based on surface finds instead of excavated sites, which makes it nearly impossible to gain any stratigraphic or environmental information (Terberger, Barton and Street 2009:197). Secondly, Schwabedissen defined the Federmesser exclusively through typology, which is no longer considered a sufficient cultural characteristic, since the general focus since has shifted from defining cultures from their typological characteristics to seeing them through a set of aspects, like material culture and technology among others (e.g. (Soressi and Geneste 2011:336; 346); see also chapter 4). Thirdly, it was custom at the time to identify archaeological assemblages which differed slightly from the typological norm, as similar, albeit different sub-groups. It remains to be seen whether or not the classification of these numerous sub-groups can be maintained based on technological criteria in the future, or if the classification instead is a relict of the scientific tradition when each typological variation was assigned its own archaeological culture. A revision of the archaeological material could help uncover differences and similarities, allowing for greater individual variety and a wider definition of the term Federmesser. However, some have even gone as far as to argue that the former separation into different groups can no longer be maintained (Ikinger 1998, in

(Brinch Petersen 2009:101)). "As far as [the Federmesser] is concerned, a large part of the complex *must now be considered an archaeological construct* in the same way as the Gudenaa culture" ((Madsen 1992:123), my translation and emphasis; see also (Paddayya 1971); (Madsen 1983:29)).

In how far ethnographic examples can be adapted to late-glacial reality, has been subject for debate. While ethnographic parallels may be compelling illustrations or provide possible explanations for what is visible in the archaeological material, any such approach cannot be seen wholly uncritical. The use of ethnographic parallels for Late Glacial groups and cultures has been subject for some discussion (e.g. (Conneller 2007:216; 233); (Riede 2007)), and the challenges associated with this should be taken into account.

The interpretation of the distinctly "spectacle-shaped" shaped tent at Borneck-Ost is based on a single reference in the original publication, in which Rust quotes a Canadian ethnographer's account of his travels and life with the Ihalmiut people of Northern Canada (Mowat 1952). This reference has itself been cause for considerable controversy, and does not render a concise description of the layout, shape or construction of a tent. While the use of an ethnographic example mainly mirrors the general interpretation practice of the time. The most problematic part is the analogy itself. Can anthropological examples really provide archaeologists with appropriate sources, or should instead an analysis speak for itself? The need for some source-critical considerations has been pointed out elsewhere (e.g. (Bordes 2000:344); (Riede et al. 2010:301)).

Re-approaching Rust's research – is the tent even built on a solid foundation? While late-glacial camps, dwellings and tent sites are by no means unheard of in the archaeological canon (e.g. (Otte 1988a); (Otte 1988b); (Burdukiewicz 1996); (Zubrow, Audouze and Enloe 2010)), the Borneck-Ost tent is of unparalleled shape and dimension. Can Rust's original interpretation be maintained, and if so, with what modifications? Are other possible layouts for the tent just as – if not more – plausible? Other options will be explored through the distribution of artefacts and refitting in particular.

Since the present study approaches a previously analysed and published site and collection, source criticism is an essential part and must be included – as a resource, not an obstacle. Existing interpretations can be challenged and re-evaluated, and contribute to an improved understanding of Borneck-Ost.

2.5 Summary

In this chapter, a framework for the Federmesser has been given. It has become evident that the existing criteria and definitions are facing a challenge from new finds and interpretations, with regard to what technological criteria among others can be considered defining elements for this culture. The discovery of new sites and surface finds has contributed with an increase in available material, and the practice of analysing assemblages with a focus on technology offers a new possibility for interpreting new and extant collections. Since the relationship between the Federmesser and its neighbouring Late Glacial periods as well as the differences in lithic technology still are subject for debate, a revision of the available material following a technological approach is evident.

CHAPTER 3

Approaching Borneck-Ost

A re-analysis of the lithic material from Borneck-Ost is entirely dependent on the material being in a condition which allows it to be analysed. Therefore, a thorough presentation of the site and the original documentation is vital. In the following pages I will present the excavations at Borneck with a focus on Borneck-Ost and the catalogue of the lithic material, as published by Rust (1958). Some emphasis will also be laid on site taphonomy and post-depositional processes in order to gain more information about the prominent stone cluster.

3.1 The site Borneck-Ost

The Borneck location (see figure 3 for an overview), was excavated between 1946-49 and encompasses four sites – Borneck-Nord, -Ost, -Mitte and-West – and three test trenches in total (Rust 1958; 1972). The sites were dug in 1 m x 1 m quadrants, but the soil was neither sifted nor differentiated according to strata. As can be seen in figure 3, the sites are attributed to different cultures: Borneck-Nord to the Ahrensburgian, -Ost to the Magdalenian/Federmesser, -Mitte to the Hamburgian (as well as a *Bornwisch*-group and *Callenhardt*-group) and -West to the Magdalenian. During Rust's excavations at Borneck, several structures, which suggest the presence of tents, were unearthed. Also, Rust observed that there was a recurring pattern suggesting disposal of flint knapping waste to the left of the presumed tents (Rust 1958:29). The artefact distribution and the different tent rings, as interpreted by Rust, are illustrated in figure 3.

A total of approximately 13 700 lithic artefacts were recovered and analysed by Rust. Osteological analyses of the organic material from the oldest phases ("Allerød, Palaeolithic, Magdalenian") at Borneck, identified bones from reindeer (*rangifer tarandus* or *arcturus*), elk (*alces alces*) and a large bovine (either *bos primigenius* or *bison bonassus*) (Herre and

Figure 3: Overview of the original excavations of the Borneck location by Alfred Rust, 1946-49. Arrows indicates the Borneck-Ost site (after Riede et al. 2010:300, fig. 3).

Requate 1958). The presence of elk is especially notable, since it still is regarded as the oldest known find of elk in Northern Germany (Riede et al. 2010). These bones have recently been ^{14}C dated, and suggest a radically different chronological assignment, placing Borneck well into the Bølling instead of the Allerød interstadial (Riede et al. 2010:307). In light of new absolute dates which directly refute the original interpretation, the chronological consequences for the Borneck finds become evident.

Borneck-Ost is first and foremost known in the late-glacial canon as a dwelling site, more precisely as home of the "Magdalenian tent", a 12 m long and 3m wide structure (see figure 4). The original excavator Alfred Rust's infamous interpretation of a large and compact stone structure as remains of a foundation for a large tent (see excavation pictures from Rust 1958) has drawn most of the attention towards the site. Since most of the lithic material from the Borneck-Ost excavation, approximately 1000 artefacts, was recovered from in-between the stone structure, the site cannot be seen wholly out of a topographic context.

Figure 4: Overview of the stone structure at Borneck-Ost, seen from south west. The entire stone structure forms the Magdalenian tent foundation (after Rust 1958:Tafel 19.1).

Late glacial tents and dwelling sites are a recurring element in Rust's research, which for instance also are present at the other tunnel valley sites of Poggenwisch and Hasewisch (Rust 1958); (Rust 1972). The possible presence of a dwelling dated as far back as to the Alleröd interstadial drew attention to the site, while simultaneously generating considerable controversy (Cziesla 1990:259 pp). Since most Federmesser-associated finds are surface finds or from a non-stratified context, the few available stratified sites, such as Borneck-Ost, still figure in modern publications. Most commonly Borneck-Ost is mentioned in critiques of either Rust as a researcher, or the presence of a tent of the suggested shape and dimensions is rejected as a whole. Nevertheless, a reconstruction of the tent at Borneck-Ost has also served as a reference for other late glacial sites with "confirmed" evidence for dwelling, e.g. Etiolles, Pincevent and Verberie in the Paris Basin, Île-de-France (e.g. (Leroi-Gourhan and Brézillon 1972), (Bordes 2000:239); (Zubrow, Audouze and Enloe 2010)).

3.1.1 Site location and topography

Borneck is located near Ahrensburg, a small town north of Hamburg, Germany (see figure 1). The area is of special geological and archaeological interest due to the hight degree of preservation of organic material in the Ahrensburgian tunnel valley. The "exact" location of the site Borneck-Ost is not known, because the coordinates are unknown. However, the State Archaeological Department of Schleswig-Holstein, has attempted to relocate the sites as part of the federal archaeological surveying *(LA/Landesaufnahme)*. It has been possible to approximately relocate the excavated locations in the tunnel valley through references to landmarks in the original publications, and also because the pumping stations used during the excavation due to large scale ground water leakage, in some cases still are visible in the landscape several decades later (Clausen, pers. comm. 2012).

Borneck-Ost could be approximately mapped because a modern-day railway track and old school house, which are visible in excavation pictures still are present. A general overview of all the locations in the Ahrensburgian tunnel valley can be found on map 1 in Tromnau (1975) – insert in figure 1 shows a detail of this map. Tromnau's map corresponds in scale with the federal survey (1:25 000). Given the date of publication, the map naturally excludes sites dug after 1975, but is still included because it is openly accessible.

3.2 Extant collection – Rust 1958

According to Rust (1958:44-45), the excavated assemblage consists of a total of 710 flakes, 190 blades and 70 artefacts ("without variable types"), among which burins and scrapers form the majority of artefacts. Some of the retouched tools were drawn and published (Rust 1958: *Tafel* 13-15). As was custom at the time of publication, the inventory is described in a brief and very subjective, non-standardised way. Some references are made to representative illustrated tools, whereas some other terms refer to types of artefacts whose classification remains unclear to the modern reader (e.g. "Gravettian points"). Rust's original categorisations have been kept in order to give an unchanged account of the first conclusive analysis of the lithic assemblage (Soffer et al. 1991).

The archaeological assemblage from Borneck-Ost (see table 2) has been stored at the *Schleswig-Holsteinisches Landesmuseum* in Gottorf Castle, Schleswig, Germany. While there may be other artefacts, only the lithic material is included in the present study. During the process of preparation of the re-analysis, all available documentation and artefacts from all of the Borneck excavations were investigated and briefly examined. Only artefacts which coincide with quadrants from Borneck-Ost (Rust 1958:53) were re-analysed.

Table 2: Inventory of lithic material from Borneck-Ost as designated in the original excavation catalogue (Rust 1958:44, 45).

Debitage product	**Total ca. 1000**	**Categories**	**Rust 1958**	**ID-2012 numbers according to present study**
Scrapers on blades	26	a) Round (8), b) straight (1), c) oblique (5), d) tanged (12)	table 13.3, 12, 16, 18-20; 13.17; 14.2, 5, 11, 18	a) n/a, 56, n/a, 69, 926, 914 b) 1198 c) n/a, 1208, n/a, 102 d) 976, 87, 66, 309, 1317, 498, n/a, n/a
Short scrapers	2	n/a	table 13.3	306
Circular end scraper	1	n/a	13.13	335
Side scraper	2	n/a	n/a	n/a
Gravettian points	4	n/a	14.14; 14.13; 14.7; 14.6	112, 68, n/a, 548
Backed knifes	2	n/a	14.8, 14.10	1316, 821
Blade with oblique retouched truncation	4	uniquely found at Borneck	14.12, 15-17	143, 819, 101, 820
Wehlen point	1	n/a	14.4	n/a
Retouched blade	1	retouch on distal end	14.11	313
Burins	21	a.)angle burin on broken blade, one face (13); b.)angle burin broken blade, two faces; c.)burin on edge, single face (2); d.)straight dihedral burin (3)	a.)15.1-2, 6-8, 10-11, 14, 16; b.)15.3-4,15; d.)15.5, 9	15.2:771
Micro tools	5	n/a	14.1-2, 5	799, n/a, n/a
Variable types	10	atypical little modification	n/a	n/a
Blades	190	not inelegant	n/a	n/a
Flakes	>700	mostly small	n/a	n/a
Cores	10	5-7 cm long	n/a	19, 32, 53, 71, 129, 490, 991, 1106, 1120, 1248, 1351, 1355, 1356
Sandstones and pebbles	8	4 each	n/a	n/a

Unfortunately, since no catalogue or documentation other than the 1958 publication is available, it is uncertain which artefacts had been described earlier, and in how far the original documentation corresponds to the totals reached in the present investigation (approximately 1000 compared to 1356) ((Rust 1958:45) and present study). The body of material used in the present investigation covers approximately 95% of the previously published assemblage. However, approximately 360 additional artefacts which had not been previously published, are also included. About halfway through the first attribute analysis, it became obvious that the lithic assemblage would far exceed the total of 1000 artefacts. Unfortunately, it was not possible to determine why this is the case, but nevertheless all artefacts which coincide with Borneck-Ost quadrants, were catalogued.

All artefacts were marked with pencil with the corresponding quadrants from Borneck-Ost. Artefacts have now been additionally labelled with ID-numbers by the present author, which are referred to as "ID-2012" on all relevant tables. In some cases, there were some other single or double digit numbers written on the artefacts. Their meaning and origin remain unknown. Additionally, several of the tools and cores have been stored in plastic bags, some of which were still sealed, some opened, and include notes describing the content. Most of these notes simply read *Magdalénienzelt* and *Zeltanlage Magdalénien*, but some describe the bags' content, including how many artefacts are unaccounted for. Apparently the Borneck-Ost assemblage has been re-analysed at some point, which could explain why some artefacts are missing. It has not been possible to relocate all of the illustrated tools (Rust 1958: *Tafel* 13-15), roughly half of these tools are absent (see table 3). All of the other available Borneck storage boxes were searched for these absent tools, and all possible whereabouts of potentially other Borneck-Ost artefacts have been discussed and cleared with Dr. Ingrid Ulbricht (pers. comm. 2012), *Schleswig-Holsteinisches Landesmuseum.*

Table 3: Artefacts missing from original publication (Rust 1958::) *Tafel* 13-15.

Table in Rust 1958	**Artefact count**	**Artefacts missing**
13 (scrapers)	20	9, 10, 15
14 (variable types)	18	2, 3, 4, 7
15 (burins)	16	all except 15.2

3.3 Site taphonomy

> "Analyzing the taphonomy of a lithic inventory is of course a necessary preliminary to any study, as it allows us to define the reliability of the lithic assemblage to answer behavioural questions."

— *Soressi and Geneste 2011:338*

While the most common criticism concerning the site is centred on Rust's argumentation *pro* tent, and especially his choice of visualisation (Cziesla 1990:261), few, if any, have attempted to investigate whether it actually is an anthropogenic structure or simply a naturally formed stone cluster. A closer look on site taphonomy is vital, and in the following pages, relevant aspects concerning site taphonomy and environmental settings will be described, as far as is possible several decades after the initial excavations. Environmental factors, e.g. bioturbation, cryoturbation, faunal activity and trampling, have inevitably had an impact on the site, and are visible in a variety of aspects, for example spatial distribution, patina and the site's general state of preservation, see e.g. (Vermeersch 1999). The impact of these external factors is, however, only determinable after all of the material has been viewed and analysed.

Sequential procedures of tool production leave patterns, as well does use of a location in general. Patterns are a material expression of human behaviour, but may as well be the result of taphonomic processes and sediment shifts. If the preservation of a site and the distribution of artefacts and remains is undisturbed enough to allow the identification of these humanly created patterns, they can be subject for further analyses (see e.g. (Leroi-Gourhan and Brézillon 1972); (Audouze and Enloe 1997)).

Very dark, patinated, black flint artefacts have been a recurring element of these inventories (Weber pers. comm. 2012). At Borneck-Ost, however, only very few artefacts were this black and thus significantly different from the others. This indicates that the lithic material at Borneck-Ost has not been disturbed in a way that would have lead to patina and colour change on a large scale. Questions concerning the degree of disturbance will be resolved through refitting (see chapter 7).

3.3.1 Environmental settings

Site formation processes will be approached in the following, through a closer look at environmental settings at Borneck-Ost. In short, the stratigraphy at Borneck-Ost has recently been found to be fairly disturbed (Riede et al. 2010:307), which reflects the general stratigraphic challenge in the area. Bioturbation, cryoturbation (*Brodelböden*) and pod-soils are the most common taphonomic causes for soil disturbance in the tunnel valley (Tromnau 1975:14-16); (Usinger 1975).

Since the local topography offers no definite answers or clues to site formation processes, a closer look at more comprehensive factors is necessary. The natural conditions at Borneck-Ost could provide important information regarding site formation processes, and potentially explain the nature of the stone structure. Because most of the lithic material was recovered from in-between the rocks, Borneck-Ost must be seen in a topographic context. Rust (1958:46; 82; 137) himself advises a critical approach, since a fair amount of problems concerning ground water leakage were encountered during the excavation. The stone cluster at Borneck-Ost is described as forming a "spectacle-shaped" structure at the foot of a hill, which forms the foundation for a double tent (Rust 1958:46 pp). The structure (see also figure 7) can be described as a slightly offset eight-shaped figure, and is a unique shape in the late-glacial research canon. Stones are less protruding from the ground in the excavated lower half of Borneck-Ost, which is also the more sloped part.

Ground water and glacial melting water must have played a role at all times at Borneck. The stone cluster is placed on the most exposed position at Borneck-Ost, making it a target for melting water. Several possibilities for how the shape of the tent foundation could have led away melting water, is illustrated in figure 5. The slightly offset eight-shape could either have forced water to run along the edge of the stone foundation, or provided a drainage across and underneath the tent. Either way could, according to Rust (1958:60-61; 137), provided a comfortable and dry shelter which justified the effort it must have taken to build this construction.

Are other interpretations possible? Is the stone structure even man-made, or caused by external factors? Unfortunately, natural conditions were not found to provide any conclusive answers to these questions, other than that they reflect the typical taphonomic – and interpretive – challenges. In how far artefacts were excavated *in situ* or if they had been washed into the stone cluster, will be assessed through the technological analysis and refitting in particular.

Photographs taken during the excavations show a somewhat broken terrain, although the extent of this cannot be determined from the available photographs (Rust 1958::) *Tafel* 16-24. A topographical map of the area was examined by the present author for the purpose of forming a better knowledge of the site location and surrounding terrain. The approximate placement of the Borneck sites was found on federal aerial laser-scans of Ahrensburg, which unfortunately is not openly accessible or available for use here (sheet 3582/5948; *Gauß-Krüger* coordinates 3581962,76/5949800,75). A slight slope in the terrain is visible, however, the scale of the aerial laser scan image is too large to provide the necessary detailed view of the site topography. It has therefore not been possible to draw reliable conclusions regarding how exactly certain local features, i.e. the stone structure, are caused by the terrain. A more detailed survey map including geological features would be helpful, especially because Rust is known for leaving sites *in situ*, in case of future excavations. The bottom part of the stone structure is preserved, and it could be useful to survey the location with geophysical

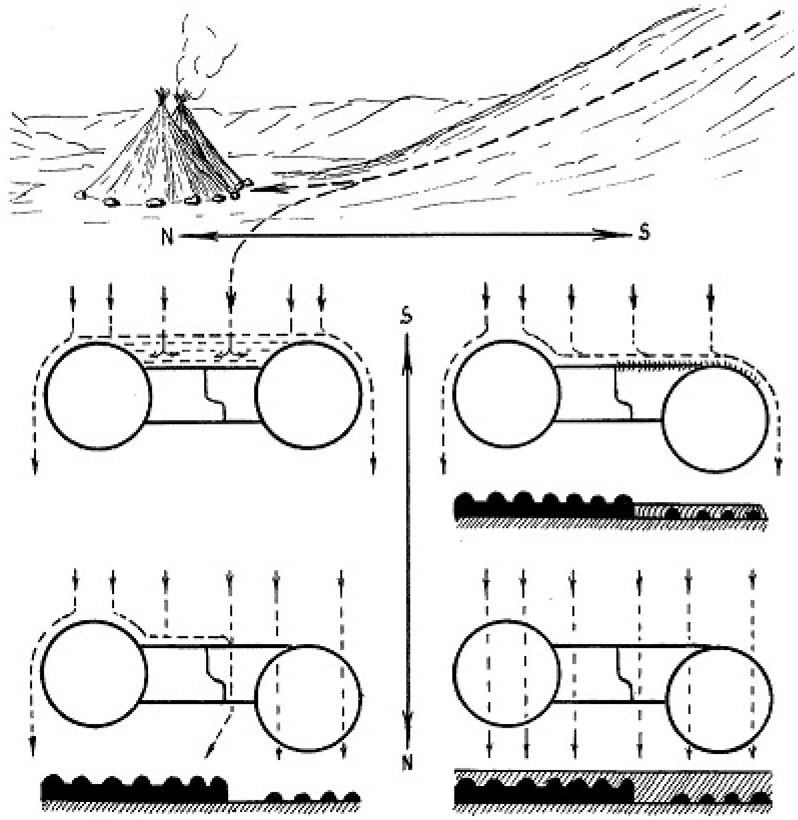


Figure 5: Illustrations showing how different layout options for the stone structure can have led away water in various ways at Borneck-Ost (after Rust 1958:61, fig. 20).

methods in order to gain further information about the natural condition of the area.

3.3.2 Raw material

Moraine flint as a source of raw material is available in significant quantities and a range of colours locally in the Ahrensburgian tunnel valley. Local flint deposits may have been visible on the ground, or been exposed from sloping hillsides due to erosion caused by watercourses in the post-glacial landscape (Madsen 1983:26; 1992:96; 1996:62). The lithic material from Borneck-Ost consists exclusively of flint, as well as a handful of sandstone slabs and some pebbles. As had been observed by (Rust 1958:44), the material is only slightly patinated, and is made of mostly brownish and greyish flint (see figure 6).

Since flint, especially the local moraine flint found in the tunnel valley can feature rapid changes in colour and pattern (Floss 2012b), colour is neither a suitable criteria for identification nor a reliable analytic tool. Still, it can be helpful and support other, more solid observations based on technological attributes. A recurring observation was how different the Borneck-Ost material is in direct comparison with the other tunnel valley sites; while

Figure 6: Example of raw material from Borneck-Ost. Left: assorted artefacts from quadrant M119, right: core 1356, images not to scale. Photographs by author.

the Borneck-Ost material is fairly homogeneous colour-wise, other Borneck and local tunnel valley sites are known for how their material ranges from yellows to purples. Some artefacts do not adhere to the main colour spectre seen in the majority of material from Borneck-Ost. While most artefacts appear to originate from the same nodules, perhaps not more than ten different in total, some cores and a few artefacts differ from this in a very bright, colourful way; either because they are coloured significantly different or because the raw material is structured in a way otherwise not encountered at Borneck-Ost (see core 1356 in figure 6). Yet, as confirmed through the technological analysis, there is no indication that the artefacts in question are foreign elements in the lithic inventory, which in turn strengthens the impression that the lithic material is the result from a short-term use of the site.

3.4 Summary

While doubts and criticism concerning the integrity of the site and Rust's interpretation prevail, I would like to argue that the site and extant collection nevertheless are suitable for re-analysis. In spite of the encountered challenges, i.e. the general Federmesser-controversy, new dates for the Borneck-bones which conflict the traditional dating, and differences in

Table 4: Type and occurrence of patina on artefacts from Borneck-Ost ($n = 1279$).

Type	**Flake**	**Flake (%)**	**Blade**	**Blade (%)**
None	685	53.56	353	27.60
Heat altered	141	11.02	22	1.72
Burnt	31	2.42	3	0.23
Burnt through	23	1.80	3	0.23
Burnt white/dead	3	0.23	3	0.23
Heat and frost altered	2	0.16	–	–
Heat and gloss	1	0.08	–	–
Gloss	4	0.32	2	0.16
Undefined	3	0.23	–	–
Total	**893**	**69.82**	**386**	**30.18**

totals reached between the previous and present study, the available documentation and material from Borneck-Ost is by far in a good enough condition to be re-analysed. The new dates essentially confirm the existing challenges at Borneck in terms of unclear stratigraphy, diffuse artefact distribution and the possible presence of palimpsests, among others (Riede et al. 2010:307). A re-analysis of the existing material is profitable.

CHAPTER 4

Methodological framework and considerations

In the following, I will examine the lithic material through a technological attribute analysis. This will form the foundation for my re-analysis of the integrity of the site, as well as of the tent-evidence, with a focus on lithic analysis and subsequent investigation of site organisation. But first I will present the methodological *chaîne opératoire* approach chosen for this study, as well as how it will be applied to the present study.

4.1 A *chaîne opératoire* approach

> *"La technique est à la fois geste et outil, organisés en chaîne par une véritable syntaxe qui donne aux séries opératoires à la fois leur fixité et leur souplesse."*
>
> — *(Leroi-Gourhan 1965:164)*

While the *chaîne opératoire* approach and its application on (lithic) technology by now is considered to be widely accepted and established, and its development and background have been covered in detail elsewhere (e.g.(Soressi and Geneste 2011)), a brief repetition is necessary.

The *chaîne opératoire* is a research methodology through which the different steps and stages of a production sequence can be systematically reconstructed, see e.g., (Eriksen 2000:75). It acknowledges the social and cognitive aspects of technology rather than maintaining a focus on classification and typology. Since technology is inseparable from the context it figures in, a society can be investigated and understood through the underlying techniques employed. The *chaîne opératoire* approach is most commonly attributed to the

French anthropologist and ethnographer André Leroi-Gourhan, who developed the method further from his teacher, anthropologist and ethnologist Marcel Mauss (Soressi and Geneste 2011:336). Whereas the earlier focus (until the 1980s) had been on recognising prehistoric societies and cultural periods through typologically diagnostic stone tools, the focus has over the past thirty years shifted towards seeing techniques as a complex social phenomenon (Lemonnier 1986); (Dobres 1999:12). Techniques are, as stated by Leroi-Gourhan in the above-mentioned quote, both action/(gesture) and tool, which ensure, maintain and form a solid framework as well as enable flexibility in production sequences.

The manufacture of artefacts is a dynamic process, by no means static from start to end. While knapping, the knapper must respond to the raw material and result of the preceding production steps, thus combining operational decisions while simultaneously making these decisions based on individual, cognitive knowledge (Bodu, Karlin and Ploux 1990:149); (Eriksen 2000a); (Eriksen 2000:48). Techniques can also be understood as repeated gestures, which in turn again are influenced by natural factors. Repetition creates a routine, which can sometimes be considered diagnostic for certain archaeological cultures (Madsen 1996); (Bleed 2001:102-105). The cognitive, individual dimension of flint knapping and production determines the outcome of the production sequence in terms of adaptation to the raw material, local conditions, execution of production, and generally the skill level reflected in the actual lithic product. Different competency levels can, on occasion, be distinguished from each other (Bodu, Karlin and Ploux 1990); (Cahen and Keeley 1980); (Van Peer 2007:97-98). Here, the identification of individual behaviour is enabled through the *chaîne opératoire* approach, whereas the possibilities for identifying the individual even in moderately small lithic assemblages previously were very limited (Bleed 2001:116-118).

Through a set of several empirical, analytic methods which were previously used individually in lithic analyses, gestures, production steps and cognitive schemes can be described and compared (Dobres 2000:166). Previously, analytical methods had emphasised the stylistic features of modified, typologically distinct artefacts, which were then sorted into typological sequences according to principles of style and technique. Debris and non-diagnostic artefacts were not subject for analysis, but this pre-selection of material excluded by far the majority of excavated material. Descriptions of style and traditional classifications are now considered stages in the process towards interpreting the "[...] evidence of human behaviour in its technical, economic and even social dimensions" (Pelegrin 1990:116).

An operational sequence is a dynamic process, but can nevertheless be represented through six basic steps, which can be supplied by additional steps (Eriksen 2000:81-83). The methods used in the present study are aimed at identifying the individual steps within this operational sequence. Questions regarding the completeness of an archaeological assemblage will be answered, as well as directly production-related issues, thus the emphasis here.

Acquisition of raw material:

Several direct and indirect possibilities exist for the procurement or acquisition of raw material (Inizan, Roche and Tixier 1992:19). Direct means of acquisition are given when raw material is directly available to the knapper, either through natural conditions, as is the case in the Ahrensburgian tunnel valley, or through somebody in the group. Indirect procurement, e.g. collecting raw material while hunting, is less easily distinguished when raw material is as available as it is in the tunnel valley (Eriksen 2000:80). An attribute analysis of a lithic assemblage may offer indications for types of procurement.

Preparation:

After the initial procurement of the material, a first preparation and early selection of suited nodules takes place. Typical preparation products are to a larger extent covered in cortex, and diagnostic. A large concentration of preparation products usually indicate the place of production. Place of production and location for use or discard do not necessarily coincide, so the identification of this step points towards what function the archaeological site fulfilled (Inizan, Roche and Tixier 1992:21).

Primary reduction or debitage:

This step includes the actual preparation of cores, and furthermore the production of blanks. This step produces the largest amount of lithic waste; basically all artefacts except for modified artefacts.

Secondary reduction or modification:

In this step, suitable blanks are further modified into tools. Retouch, burin spalls, half-fabricates and other diagnostic bi-products of modification are indications for this production step (Eriksen 2000:82).

Use:

During the use of an artefact, further modifications may be undertaken, which will produce similar bi-products as the preceding step, but also leave use-wear traces, e.g. impact fractures or remains from mounting. The use-cycle of artefacts may also include maintenance and recycling (Eriksen 2000:82).

Discard:

The last stage in a production sequence is necessarily when an artefact is abandoned, either through loss, discard or deposition (Eriksen 2000:82).

It is important to note that the empirical, descriptive aspect of lithic analysis still form the essential basis for all lithic analysis, which also has largely benefited from the increasing amount of information which has been made available through experimental archaeology; see e.g. (Apel and Knutsson 2006); (Madsen 1983); (Madsen 1992); (Sørensen 2006); (Olausson 2000). Analytical methods are now increasingly applied in a combined approach, and, when seen in a larger context within the *chaîne opératoire*, "allow researchers to move beyond sterile questions of typology, function, and even the style-function debate" (Dobres 1999:168); see also (Edmonds 1990:57).

How the *chaîne opératoire* approach will be applied in the present study

Since much of the study of the Late Glacial in Northern Europe is still deeply rooted in typology and German terminology (Madsen 1992:93), and it has become evident how there is reason to question the existing typologies for some periods, and in particular the Federmesser, an analytic approach detached from a rigid, traditionalist framework offers the best possibilities for further study. For the present study, the operational steps which were presented here will serve as a framework for through the technological analysis. The lithic assemblage from Borneck-Ost will be approached, and questions relating to lithic production, use, discard and condition of preservation of the extant collection will be resolved. Following the initial analysis, important aspects connected with the operational sequence will be discussed. One must *move beyond* typology, and continue the use of technological analysis for the overall aim of establishing reliable criteria for the Federmesser.

Technical criteria are the most compelling for this kind of statement, especially when the collection in question was excavated, analysed and published several decades earlier. Ideally, it will be possible to draw some conclusions regarding all steps of the operational sequence through this approach, regardless of whether or not the material is homogeneous or not. Should certain steps be missing or over- or under-represented, this will equally contribute to the analysis. On the basis of the technological analysis, some conclusions regarding the operational as well as the cognitive scheme can be drawn: what was the intended end product, and what operational decisions were undertaken by the knapper? Also, were different individuals involved in the process? If so, how can these be distinguished from each other? Refitting will play a central role in answering these questions, as well as provide information regarding the site (organisation and taphonomy) itself (Bodu, Karlin and Ploux 1990:146); (Milliken 1998); (Schurmans and De Bie 2007).

CHAPTER 5

Lithic assemblage – present study

An attribute analysis of all available lithic artefacts from Borneck-Ost forms the basis for the technological analysis, which is carried out according to a set of empirical, analytical parameters. These parameters will be presented here, as will the lithic assemblage according to the present study. Available technological studies for other late-glacial flint-working traditions will be consulted for comparison (Madsen 1983); (Madsen 1992); (Madsen 1996); (Caspar and De Bie 1997); (De Bie 1999); (Pelegrin 2000); (Sørensen 2006). Also, the distribution of artefacts according to the original publication and the present study will be shown and discussed.

5.1 Parameters of present study

For the re-analysis, the lithic artefacts were first laid out according to quadrants, then separated into type groups according to archaeological criteria (Auffermann et al. 1990). A first comprehensive study guide to approaching late-glacial lithic material was compiled by (Madsen 1992), on the basis of material from the Hamburgian sites of Jels, Denmark, as well as Madsen's own previous experimental work. Through experimental knapping, Madsen identified the characteristic features for the use of soft hammerstones, which were also recognised in the present study (Madsen 1983). This set of criteria has later been supplied by (Sørensen 2006), who adapted the study guide to suit an analysis of several Maglemose sites in Denmark. A combination of both study guides forms the basis for the present study. Due to the different chronological and geographical settings as well as differences in production sequences, these study guides cannot be wholly applied to the present study. It was felt that Madsen's criteria differentiated less strictly between different morphological and technological aspects, which have been categorised separately here by the present author (cf. (De Bie 1999); (Weber 2012:39)).

Criteria are as follows: ID-2012 number, quadrant, patina, fracture/modification, length, width, thickness on all available artefacts (all in mm), amount of cortex present on dorsal sides (recorded in thirds), degree of curvature. The degree of curvature (in table: straight/curved) is not based on metric features, but instead on a subjective observation of whether or not the artefacts "tip over" from side to side when placed ventral side down. This method is obviously not ideal, but nevertheless served as a quick way to determine the convexity of an artefact, thus allowing it to be approximately placed within the production sequence (Soressi and Geneste 2011:338).

Furthermore, the number of negatives on the dorsal surface, knapping mistakes, size of striking platform according to (Madsen 1992:105), condition and shape of striking platform is noted. The characterisation of cones, bulbs, platform (smooth/faceted), platform preparation were executed according to (Madsen 1992:105), (Pelegrin 2000:79) and (Sørensen 2006:27). Additional criteria inventory lips, retouch, debitage product, possible refits onto, and cross-references to Rust (1958). These criteria were determined to be the most suitable with regard to the technological focus of this re-investigation.

5.2 Definitions and nomenclature

The technical terms and descriptions used here follow the standard terminology suggested by (Inizan, Roche and Tixier 1992) and (Floss 2012a). Since English definitions for some of the debitage product categories mentioned in the original documentation are unavailable, translations have been used which correspond as closely as possible to the original terms (Soffer et al. 1991). In some instances the terminology from labels in the extant collection have been retained to allow future comparisons.

Rust categorises and dates the inventory based on the presence of what he interprets as characteristic late-glacial artefacts. An approximate terminology for these can be found elsewhere (Schwabedissen 1954). The extant collection was classified as Federmesser, type *Wehlen* group (Schwabedissen 1954:6), based upon typological features. As stated by the original excavator, "the Magdalenian *habitus* of our industry is explicitly expressed through the presence of Gravettian points, tanged scrapers and the typical primitiveness of burins" (Rust 1958:45, my translation). The inventory is representative for a group/culture that travelled northwards during the Alleröd interstadial, and neither Hamburgian nor Ahrensburgian (ibid.). The Federmesser is no longer considered a late-Magdalenian culture, and results from the technological analysis do not support Rust's argument.

Differences in totals reached in the present study compared to the previously available documentation can be explained through differences in hand specimen characteristics as well as changes in nomenclature (Tromnau 1975:20); (Nash et al. 2013). The largest deviation from the previous record can be see in the number of blades (190 compared to 358). While Rust's *formal* definitions are unknown, it is likely that he identified *ideal* blades through personal experience and observation, as well as according to the typological tradition of the time, instead of using standardised definitions. In the present study, blades are defined as artefacts with a length/width ratio of $\geq$ 2:1 (Bordes 2000); (Inizan, Roche and Tixier 1992:76).

5.3 Lithic assemblage according to present study

5.4 Artefact distribution

The distribution will be presented in three different ways. In this chapter, the artefact distribution for quadrants with more than 15 artefacts is included (see figure 7). Two different maps from Rust 1958 will be used, and the different artefact distribution patterns (past/present study) will be illustrated in both. The first map will include the drawing of the stone structure (1958:52, fig. 15) (see figure 19), the second option will instead be Rust's explicit interpretation/his tent ring drawings (1958:53, fig. 16) (see figure 18). A comparison of both offers the reader the possibility to compare the stone structure with the often criticised, already-interpreted tent layout.

The stone cluster at Borneck-Ost (see figure 4) has been described as a man-made foundation for a late-glacial tent. Two main tent rings which are connected through a paved passage, were identified, each of which served a different purpose. According to the original excavator (Rust 1958:55 pp; 1972:170 pp), the recovery of burnt artefacts as well as charcoal from the quadrants assigned to the upper tent ring, as well as the distribution pattern of artefacts in general, confirmed his tent hypothesis. Unfortunately, no charcoal samples have been dated or preserved (Rust 1958:47).

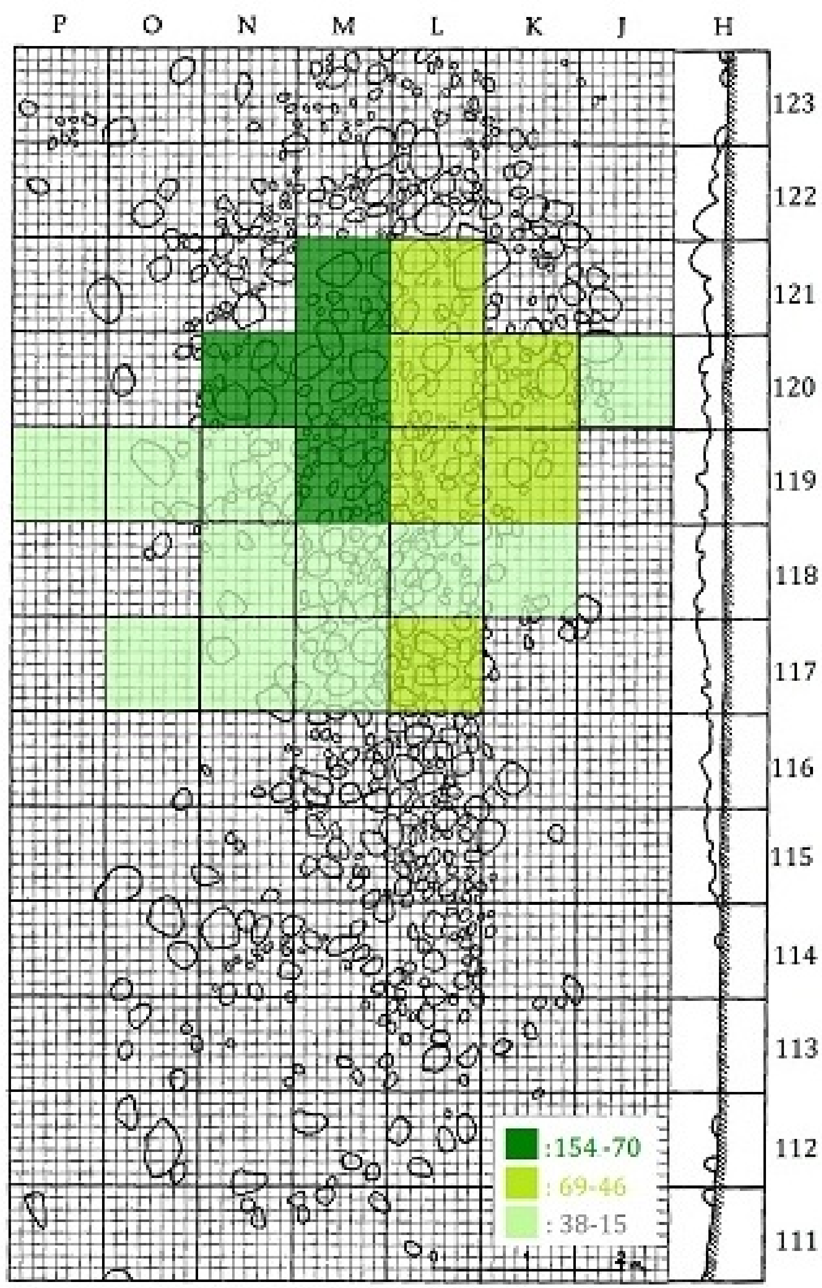
Since few artefacts were recovered from the quadrants attributed to the lower half of the location, this has been interpreted as a sterile tent ring. It has been argued that the upper, slightly larger, tent ring provided shelter, while the other tent served as storage. In all distribution maps, the x-axis represents a letter (H-P), and the y-axis letters (111-123). Artefacts were recovered from 64 quadrants, and the largest concentration found in quadrants M119, M120, M121.

The distribution pattern according to the present study, however, shows a slightly different image. Artefacts are found in 73 quadrants, and while quadrant M119 still features the largest concentration, the totals reached for each quadrant differ significantly. This can partly be explained through the additional artefacts from Borneck-Ost, which have been included in the re-analysis, but were previously unaccounted for. Also, while the upper row of quadrants (rows H123-P123), previously was considered sterile, a total of 46 artefacts can be found there now. Rows 123, P and U were previously attributed to an Ahrensburgian and *Callenhardt*-group camp (Rust 1958:57; 61), but refits of some artefacts from those rows onto the Federmesser assemblage point towards a different picture.

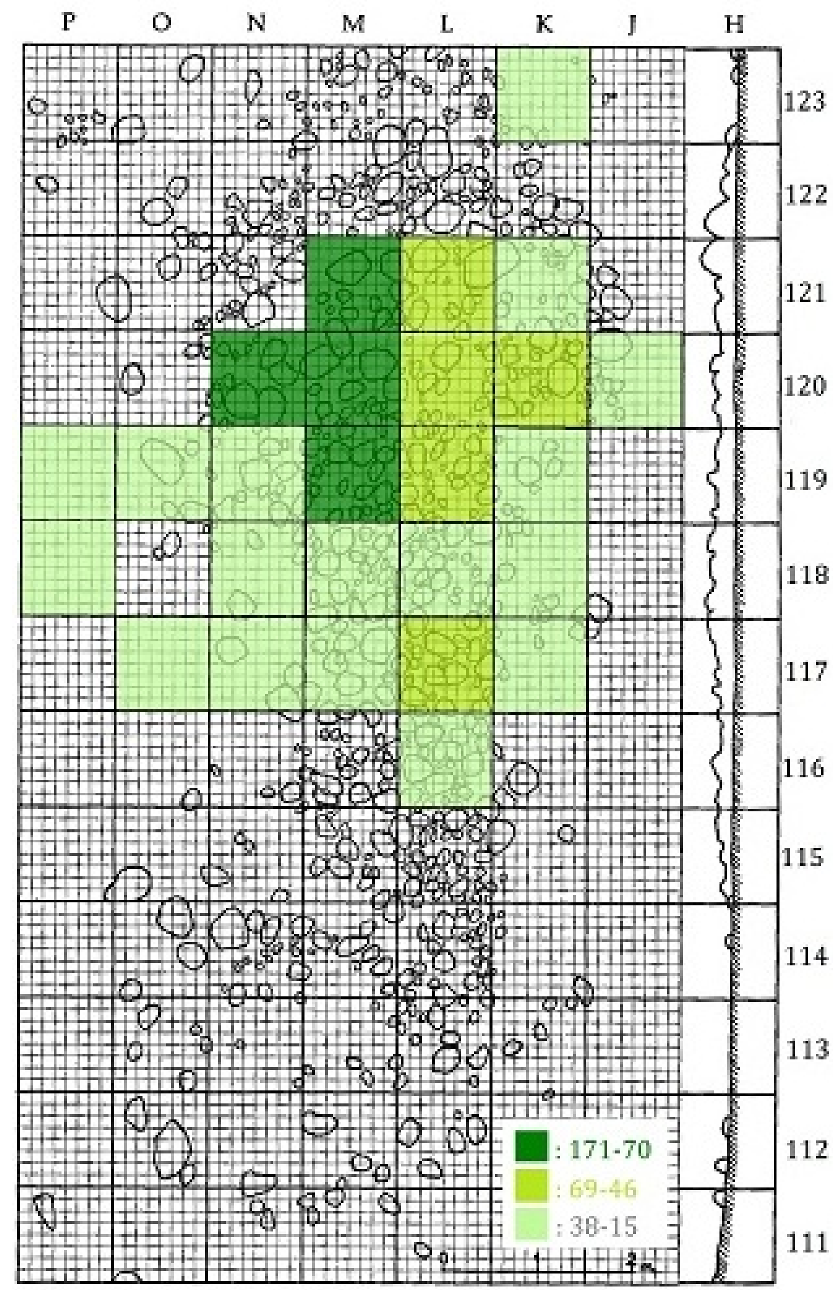
The distribution of burnt and heat altered artefacts coincides with the quadrants with the highest concentration of artefacts, centred around quadrant M119. This observation is in accordance with the placement of a fireplace in the middle of the dwelling (Rust 1958:51; fig. 14).

Table 5: Lithic assemblage from Borneck-Ost according to present study ($n = 1351$).

Debitage product	**Count**	**%**	**ID-2012 (present study)**
Flakes	890	65.78	
Blades	358	26.46	
Crested blades	23	1.70	82, 108, 182, 278, 292, 352, 491, 520, 764, 766, 836, 857, 931, 962, 1110, 1199, 1203, 1234, 1265, 1272, 1298, 1309, 1340
Crested flakes	2	0.15	155, 156
Cores	11	0.81	19, 32, 53, 71, 129, 490, 991, 1106, 1120, 1248, 1351, 1355, 1356
Core fragments	17	1.26	19, 71, 114, 115, 130, 134, 152, 158, 159, 256, 385, 434, 492, 598, 604, 1264, 1344
Core flake	1	0.07	298
Core tablet	1	0.07	276
Plunging blades	2	0.15	307, 1226
Burins	2	0.15	163, 1087
Scrapers	19	1.40	87, 260, 306, 308, 309, 335, 336, 498, 561, 585, 631, 976, 1155, 1156, 1161, 1180, 1239, 1273, 1317
Scraper fragments	2	0.15	170, 230
Scrapers on blades	4	0.30	914, 926, 1198, 1315
Scraper on crested blade	1	0.07	69
Wehlen scraper	1	0.07	66
Federmesser	1	0.07	112
Blade w/ oblique retouched truncation	2	0.15	143, 1208
Eolith	1	0.07	70
Pebbles	8	0.59	666, 879, 915, 948, 1006, 1018, 1267, 1296
Potlids	5	0.37	127, 509, 538, 628, 1270
Total	**1351**		



(a) Distribution according to Rust 1958:53, fig. 16.)



(b) Distribution according to present study.

Figure 7: Distribution patterns of artefacts from Borneck-Ost. Quadrants with fewer than 15 artefacts have been excluded (after Rust 1958:52, fig. 15).

CHAPTER 6

Technological analysis

The presentation of the results from the technological analysis will follow the steps of production according to a traditional *chaîne opératoire* (see chapter 4). The first steps of production as well as recorded knapping attributes is given ahead of a presentation of modified artefacts and tools. The artefact categories *blades* and *flakes* used in tables throughout the present study include combined artefacts, like scrapers on blades. Additional figures and tables can be found in the appendix.

6.1 Knapping attributes

The first removals off a core will naturally feature the largest amount of cortex or outer surface present on the dorsal surface. Therefore, determining the amount of cortex present will provide an overview of the sequence of removals (see table 8). Also, as stated by Soressi and Geneste, "as cortex cover diminishes, so should the size of the artefact" (Soressi and Geneste 2011:338).

Technological attributes, as seen on flakes and blades, form the basis for the present study. Combined artefacts, such as scrapers on blades or crested flakes, have here been included in the general, broad definition of categories. Tools are made on both blades and flakes. Since these two categories constitute the largest amount of artefacts in the extant collection, and it can be argued that modified artefacts are, essentially, either flakes or blades. Therefore, a thorough presentation of mainly flakes and blades will constitute the foundation for the technological analysis.

6.1.1 Condition of assemblage

Artefacts have been inventoried according to type of fragmentation (see table 6; e.g. (Madsen 1992:99); (Sørensen 2006:28-29)). Absence of the distal end is the most commonly occurring type of fracture (recorded 443 times/32.94%), as is the preservation of only the medial part of artefacts (442/32.86% in total). This frequent occurrence of fractures naturally influences the preserved length of artefacts. As a consequence, all discussions concerning artefacts' possible lengths must be seen with caution. While fractures may occur due to taphonomic reasons and post-depositional processes like frost, forest fires, trampling (Vermeersch 1999), and thus serve as a means of determining the collection's overall state of preservation, fractures may also point towards which knapping technique was used, since different techniques and hammers produce e.g. diagnostic breaks. No breaks *en nacelle* or *en lancette* were found.

Table 6: Condition and completeness of artefacts from Borneck-Ost (classified according to Sørensen 2006:29, fig I).

Fracture/modification	$n = 1345$	%
Bulbar fragment	41	3.05
Complete	314	23.35
Distal end	4	0.30
Medial	442	32.86
No distal end	443	32.94
No proximal end	101	7.51

6.1.2 Dorsal scars

Table 7: Types of dorsal scars. Since different types can occur simultaneously on the same artefact, multiple values apply ($n = 2094$ dorsal scars).

Type	**Flakes**	**Flakes %**	**Blades**	**Blades %**
Cortex	216	10.32	71	3.39
Heat damage	97	4.63	9	0.43
Opposite	91	4.35	78	3.72
Same direction	507	24.21	302	14.42
Shatter	24	1.15	2	0.10
Transverse	476	22.73	221	10.55
Total	1411	67.38	683	32.62

Another aspect which points towards the internal hierarchy of removals, is a closer investigation of negative removals on dorsal surfaces, so-called dorsal scars (see table 7). An artefact knapped at an early stage of production will have fewer negative dorsal scars compared to a "later" artefact. The number of dorsal scars as well as the direction of removals have been recorded, in order to record information about core preparation and alternating knapping directions (Sørensen 2006). Types of dorsal scars which were encountered are: knapped from the same, opposite or transverse direction of knapping as the artefact itself. Transverse removals may result from core preparation through cresting, a method in which removals are struck transversely off the face of a core (see e.g. (Inizan, Roche and Tixier 1992); (Sørensen 2006)).

While cortex and heat damages are, strictly speaking, no knapping attributes, their presence has been included, thus allowing debitage products to be placed within the production sequence, as well as presenting information regarding heat alteration. Because different types of dorsal scars can be found on the same dorsal surface, multiple values apply. A general observation is that most artefacts from Borneck-Ost were knapped from the same direction; the direction of dorsal removals is the same as the direction from which the artefact was knapped. These artefacts feature no dorsal scars struck from the opposite direction. A significant number of artefacts have dorsal scars which have been knapped exclusively from the opposite direction. This is often seen in combination with transverse dorsal scars, which figure quite frequently.

6.1.3 The proximal ends

At the proximal end of an artefact, several knapping attributes contribute towards an understanding of applied technique. The size of the platform (see table 13), as well as the condition of the proximal ventral surface indicate which knapping technique in combination with which kind hammer stone was applied in the production sequence. The occurrence of characteristics such as lips (see table 16), cones (see table18) and bulbs/bulb scars/*esquillements de bulbe* (see table 17) are all symptomatic. *Esquillement de bulbe*, a special type of bulbar scar which resembles crushing near or at the bulb, is diagnostic for the use of a soft hammer stone, e.g. (Pelegrin 2000:78-80); (Madsen 1983); (Weber 2012). Additionally, information concerning the striking platform itself, its composition and preparation (see tables 14 and 15) show how the knapper has influenced the outcome of the knapping product.

The purpose of the technological analysis is to determine if the lithic assemblage is homogeneous or if the site has been disturbed. Knapping attributes and applied techniques can also help determine the state of an extant collection – were there to be found technological contradictions, these might indicate disturbance and heterogeneity.

Table 8: Amount of cortex present on dorsal sides of artefacts ($n = 1341$). Classification according to present author.

Amount of cortex	**None**	%	**<1/3**	%	**1/3**	%	**>1/3**	%	**1/2**	%	**<2/3**	%	**>2/3**	%
Flakes	563	41.98	205	15.29	7	0.52	54	4.03	19	1.42	15	1.12	26	1.94
Blades	272	20.28	54	4.03	2	0.15	15	1.12	2	0.15	6	0.45	7	0.52
Crested blades	9	0.67	10	0.75	–	–	2	0.15	–	–	2	0.15	–	–
Crested flakes	2	0.15	–	–	–	–	–	–	–	–	–	–	–	–
Cores	5	0.37	4	0.30	–	–	–	–	–	–	–	–	2	0.15
Core fragments	3	0.22	9	0.67	–	–	2	0.15	–	–	2	0.15	–	–
Core flakes	1	0.07	1	0.07	–	–	–	–	–	–	–	–	–	–
Core tablet	2	0.15	1	0.07	–	–	–	–	–	–	–	–	–	–
Plunging blade	–	–	1	0.07	–	–	–	–	–	–	–	–	–	–
Scrapers	10	0.75	5	0.37	–	–	3	0.22	–	–	–	–	1	0.07
Scraper fragments	1	0.07	1	0.07	–	–	–	–	–	–	–	–	–	–
Scrapers on blades	4	0.30	–	–	–	–	–	–	–	–	–	–	–	–
Wehlen scraper	–	–	–	–	–	–	–	–	1	0.07	–	–	–	–
Federmesser	1	0.07	–	–	–	–	–	–	–	–	–	–	–	–
Blade w/ oblique retouched truncation	1	0.07	1	0.07	–	–	–	–	–	–	–	–	–	–
Burins	1	0.07	1	0.07	–	–	–	–	–	–	–	–	–	–
Potlids	5	0.37	–	–	–	–	–	–	–	–	–	–	–	–
Total	**880**	65.62	**293**	21.85	**9**	0.67	**76**	5.67	**22**	1.64	**25**	1.86	**36**	2.68

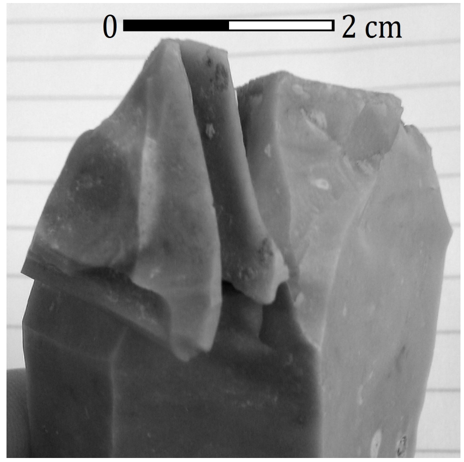


Figure 8: Figure showing refit group detail of two hinged flakes on core 490, photograph by author.

6.1.4 Knapping errors

Knapping errors are important informants for both the operational as well as the conceptual scheme of a production sequence. With regard to the first, knapping errors can indicate whether the appropriate technique was chosen for the production of the intended end product. With regard to the latter, the occurrence of knapping errors is also inextricably intertwined with the knapper's personal skill level. Whether or not a knapper was able to adapt his or her individual knowledge and technique to the available raw material nodules and local conditions, as well as whether the knapper was competent/adept to produce the desired product at all, can be read from the material record. Hinges and step breaks are the most commonly occurring errors in the present study (see table 19). Some errors are caused by natural flaws in the material, and others by mishaps.

Knapping errors were seen in a total of 257 flakes (70.22%) (see table 19), most commonly in the form of hinged distal ends (see also figure 8). Hinged distal ends in combination with ripples on the ventral surface were found just as often as ripples on their own. A few cases of step breaks were also seen. Concerning blades, hinges and ripples are also the most common knapping errors, as well as a combination of both, all represented to en equal extent. In contrast to knapping errors seen on flakes, no step breaks were found on blades.

6.1.5 Flakes

Flakes represent the majority of debitage products in this extant collection, as can be seen in table 5. Flakes found at Borneck-Ost are for the most part characteristic, unmodified production waste flakes, as well as a few debitage flakes (core rejuvenation flakes) (see e.g.

(Inizan, Roche and Tixier 1992:38-39)). Since flakes are available in significant quantities, the largest variation of various knapping attributes is seen in this debitage product category. Flakes from all stages of production are represented in the extant collection.

Degree of cortex coverage

Regarding the degree of cortex coverage on the dorsal surface, all options are available – from a few, initial, heavily cortex covered opening flakes to a large number of flakes which are not covered in any cortex at all (see table 8). Flakes at Borneck-Ost reach lengths of up to 103 mm, and widths of 64 mm. It was felt that the use of a graphical representation of artefacts' dimension did not contribute to the re-analysis, and has therefore been omitted. Since not all flakes are completely preserved, it is important to keep in mind that these numbers are only approximates. 579 of the 892 flakes are curved, whereas 313 are straight.

Dorsal scars

As can be seen in table 7, different types of dorsal scars can be found on flakes, often appearing in combination with each other. The most common dorsal scars are negative removals from the same direction, or transverse to the artefact's knapping axis. Cortex, external factors such as heat alteration, as well as negative removals opposite to the axis also occur. However, not all possible combinations are seen – "same direction" and "transverse" dorsal scars appear together, as do "transverse" and "opposite" dorsal scars. "Same direction" and "opposite" were, however, not found in combination with each other. This implies that flakes were not intendedly struck from alternating directions, instead, opposite and transverse correcting flakes were struck on occasion.

Platform and butt

Concerning the butts/striking platform, several different knapping attributes were investigated. Butts are for the most part broad, although, as is shown in table 12, no clear pattern or preference could be identified. With regard to the shape of the butts, a tendency towards geometric shapes in general and a rectangular shape in particular can be seen in table 13. The composition of the platform can render information regarding the striking platform of the core. For the most part, platforms are smooth, although faceted platforms also occur somewhat frequently (see table 14). Platform preparation, which is listed in detail in table 15, has been differentiated according to Madsen (1992:105, fig 70 F). Large dorsal trimming is the most common kind of preparation, followed by isolated and small trimming. The earlier mentioned faceted platforms are confirmed by the presence of various types of platform preparation executed on the platform itself.

Proximal end

The condition of the proximal end is an indication of the knapping techniques and hammerstones used in the process. A very detailed overview of all available options is found in table 17. Single bulbs and *esquillements de bulbe* are the most common characteristics, followed by bulbs in combination with a bulb scar. Lips and cones, each diagnostic for different hammerstones, are also visible on the butt. Pronounced lips occur more often than lips (see table 16), while cones commonly appear on the ventral side of the butt. A range of different cone types, as well as their frequency in the extant collection, is listed in table 18.

6.1.6 Blades

The presence of blades in as significant numbers as in this extant collection, already implies that blades were indeed the desired end products. Blades are the second largest debitage product group in the extant collection (see table 5). Most blades from Borneck-Ost are unmodified, while debitage blades (e.g. crests) also are available. Blade production generally requires core preparation in terms of shape, volume, faces and platforms (ibid.).

According to the original excavator (Rust 1958:45, translation by present author) "blades (approximately 190) have an average length of 5-6 cm, while the longest examples measure 10 cm. These unretouched blades have a thin cross-section and are not inelegant." Rust's quote highlights how blades were categorised according to visual and subjective criteria, as opposed to the metric, now standard definition. The largest blades allow for conclusions regarding the original size of the core; blades in the extant collection reach lengths of 115 mm and a maximum width of 37 mm. Again, these measurements must be treated with some caution, because fragmentary as well as complete blades are preserved. The dimensions reached are only approximates. Out of 386 blades available for the present study, 180 are straight and 206 are curved.

Dorsal scars

The majority of dorsal scars surface originate from the same direction as the blade itself was struck. Transverse and opposite dorsal scars also occur with some frequency, as can be seen in table 7. As with flakes in the extant collection, not all possible combinations of the available dorsal scar types were found. Again, "same direction" and "opposite" scars appear never in combination with each other, whereas combinations of "same direction" and "transverse", and "opposite" and "transverse" were found. The latter combination is partly due to core preparation, which is also confirmed through the presence of characteristic crested blades at Borneck-Ost.

Knapping attributes

Moving on to the knapping attributes seen on the proximal part of blades, the platforms are for the most rectangular or oval (see table 13), and almost always either smooth or faceted (see table 14. In comparison to flakes, fewer variations in platform shape and composition were recorded. Concerning platform preparation, which is shown in table 15, the same kind was used for flakes as for blades, with the difference that small dorsal trimming is the most common type of platform preparation of blades.

Table 17 lists the available conditions of the proximal end of blades. Bulbs and bulb scars, also in combination with each other, occur frequently. Here, some differences between flakes and blades can be seen. For instance, while a single bulb scar is the most common characteristic on blades, it appears relatively rarely on flakes (107 compared to 24), and vice versa – *esquillements de bulbe*, min. 105 on flakes compared to 27 on blades, seem to be characteristic for flakes at Borneck-Ost. Lips and pronounced lips, see table 16, were found in equal numbers on a small number of blades in the extant collection. As can be seen in table 18, cones were on occasion found on the ventral side of the butt, as well as on the platform itself and the butt.

6.1.7 Cores

Cores directly display important information about the production sequence, like desired end products, the operational scheme, the knappers's technological knowledge as well as the individual skill level can directly be read like a biography off a core's surface (Pelegrin 1995:146). According to the original publication, altogether ten cores were excavated. These range from 5-7 cm in length, and feature no special characteristics according to (Rust 1958:45). In the past, cores were rarely subject for extensive descriptions, and it is only of recently that cores and their position within a lithic assemblage as well as the *chaîne opératoire* itself have come into attention. My studies showed several characteristics on the cores from Borneck-Ost (see figure 9), some of which are shared, while others are singular appearances.

According to Hartz (2012:393-394), Federmesser cores are both uni- and bipolar, acute-angled cores (Bokelmann, Heinrich and Menke 1983). These appear to differ from each other in degree of platform preparation and the presence of faceted platforms (ibid.). Conical and cylindrical cores are known from Denmark (Andersen 1988); (Fischer 1988). While Federmesser cores morphologically share the desired end product with Hamburgian cores, they are of lesser quality than Hamburgian end products. Examples for both hard and soft knapping technique are known (e.g. (Clausen and Hartz 1988:fig. 1); (Lempke 2000)), as is

Figure 9: Assorted cores from Borneck-Ost. Photograph by Mara-Julia Weber.

also the case in the present study.

A total of thirteen cores were found in the extant collection (see selection in figure 9 and illustrations in appendix). These could be classified as core fragments and exhausted cores (c.f. (Inizan, Roche and Tixier 1992)). While the end product is indeterminable on some, negative blade removals on the majority of cores indicate blade production. This observation is consistent with the general shape, as well as the kind of core preparation visible on most cores, which will be presented later. As can be seen in table 9, cores reach lengths between 40 and 91 mm, but must have been longer. The minimum size of the original nodules can be reconstructed from the longest available flakes and blades, and as a production sequence is carried out, the size of the core naturally decreases (Soressi and Geneste 2011). Cores from all stages of production were excavated; the amount of cortex left allows them to be placed within the production sequence. The majority of cores contain either little (>1/3), or no cortex at all. The cores with the highest percentage of cortex present were abandoned at an early stage, which is supported by the presence of recurring erroneous removals. A further indication of the length of use is the number of negative removals, ranging from 10 to 35 – the more removals, the older the core.

Further knapping attributes can be found on table 10. It is a recurring observation that the direction of knapping was alternated. On most cores, blades were struck from one

Figure 10: Frost damaged core preparation refit group from row Q, Borneck-Ost. The refitted artefacts form a "peel", and the internal core was not found in the corresponding storage. Image not to scale, ca. 1:3. Photograph by author.

prepared face. All but one core have more than one platform, and subsequently removals from multiple directions. It was unfortunately not possible to see whether platforms were systematically alternated, or arbitrarily, or if the opposite platform was used auxiliary in order to correct hinged removals. Hinged removals leave step breaks on the core, a common characteristic shared by all cores in the extant collection. Two distinctly hinged flakes could be refitted onto each other as well as onto core 490 (see figure 8). In most cases repeated step breaks led to the abandonment of the core, although additional platform preparation on abandoned cores was observed on occasion (cores 19 and 53, see figure 22).

On the basis of the recorded knapping characteristics, some assumptions regarding preferred shape, volume and placement of platforms can be made, since a set of characteristics are shared by several cores. In terms of shape and volume, conical and cylindrical cores appear to have been best suited for the intended purpose. The types of core preparation show a tendency towards shaping of volume and platform preparation (see table 10). Some cores were extensively prepared, while platform preparation is absent on some others. Several of the striking platforms were knapped, at times without success, which is seen in step breaks on the platforms. As can be seen in figures 31 and 20, striking angles vary from 52° to 96°. A tendency towards a specific angle could not be observed. Core `129` bears close resemblance to a Hamburgian core (Hartz, pers. comm. 2012). Through direct comparison with Hamburgian cores from the Teltwisch site, Germany, this impression could be proven wrong, since the cores are substantially different from each other (Weber, pers. comm. 2012).

According to Rust (1958), the artefacts found in row Q can be attributed to a *Callenhardt*-group camp. When the extant collection was first approached last fall, Rust's instructions were followed, and the artefacts which coincided with row Q, were not inventoried. As a simple means of practice, most of the Q-artefacts were refitted into a refit group which could best be described as the exterior peel or layer of a core – the core itself was not present (see figure 10). The material differed from the other material at Borneck-Ost in several ways, since it was heavily frost damaged, and coloured in grey, purple and pastel yellow. The frost damages run throughout the material, and the nodule must have obviously not been well suited for knapping purposes (Inizan, Roche and Tixier 1992:18). Yet, interestingly, it was prepared, and the volume corresponds with the conical cores found in the neighbouring quadrants. It appears as though frost damaged cores were worked on occasion, both in the Palaeolithic as well as the Mesolithic (e.g. (Madsen 1996:62); (Brinch Petersen 2009:105)).

The knapping of a few unlikely nodules (e.g. the palm-sized flints slabs, core `1120` in figure 28 especially), small and seemingly not well suited for blade production, but from which successful blades were struck nonetheless, challenges the impression of a single, standardised ideal core. Instead, it illustrates a high level of adaptation to locally available material, as well as it opens up for discussion related to a high – operational and conceptual – skill level.

6.2 Modified artefacts

As stated in e.g. (Inizan, Roche and Tixier 1992:30); (Eriksen 2000:81), secondary modified artefacts represent the last stage of a production sequence, and usually form a small percentage of the total excavated material. Additional steps are added to the production sequence; through retouch and other modifications, a blank is converted into a tool. The classification of and differentiation between modified artefacts and tools has been subject for substantial debate, and remains problematic at times – should technological or morphological criteria be employed? When is an artefact modified, when can it be characterised as a tool?

The identification of tools at Borneck-Ost also showed to be problematic at times, since a fair amount of artefacts appear to have been modified into tools *ad-hoc*. Several examples of scrapers which were created spontaneously on a crested blade are available; see also (Baales

Table 9: All 13 available cores from Borneck-Ost, metric characteristics.

ID-2012	Height mm	Width mm	Thickness mm	Faces	Platforms	Cortex	Negatives
19	75	64	34	1	4	<1/3	20
32	72	67	30	4	4	>2/3	20
53	51	45	47	3	4	–	35
71	40	26	17	1	1	–	13
129	89	53	46	1	3	<1/3	29
490	70	35	35	1	2	–	27
991	89	68	49	1	2	<1/3	26
1106	67	43	37	1	2	–	23
1120	59	82	30	1	2	>2/3	22
1284	48	42	24	2	3	–	27
1351	91	63	71	2	3	<1/3	22
1355	54	29	23	1	2	<1/3	10
1356	68	29	34	1	2	–	10

Table 10: All 13 available cores from Borneck-Ost, non-metric characteristics.

ID-2012	Quadrant	Artefact type	Preparation	Shape	Final product
19	J120	core fragment	platforms only partially	rectangular	flakes
32	J121	core fragment	all platforms	flint slab	indeterminable
53	K117	core fragment	all platforms	cubic	indeterminable
71	K118	core fragment	shape; platforms	cylindrical	indeterminable
129	K120	core	indeterminable	conical	blades
490	L121	core	shape	cylindrical	blades
991	N120	core fragment	shape; platform	conical	blades
1106	N123	core	shape	cylindrical	indeterminable
1120	O112	core fragment	cortex removal	flint slab	blades
1284	P118	core fragment	indeterminable	triangular	indeterminable
1351	L117	core	cortex removal; shape	rectangular	blades
1355	K118	core	cortex removal	cylindrical	blades
1356	O123	core	shape; platform	cylindrical	blades

and Street 1999:229). Their categorisation is ambiguous. For the present study, all modified artefacts with intentional or substantial retouch are defined as tools; this includes scrapers, burins and curved backed blades.

Since the nomenclature used by the original excavator unfortunately is not known, it cannot be determined if all of the previously accounted for tools (Rust 1958:44-45; tables 13-15) were inventoried as well in the present study. As was mentioned earlier, some of the drawn tools are missing. Also, since it is not known to what extent artefacts "had to" be modified in order to be recognised as tools by Rust, the results presented in both catalogues are not comparable. As is common for most sites, tools represent a small percentage of finds at Borneck-Ost. In the original publication, various types of scrapers and burins are the most commonly occurring tools (see table 2 and (Schwabedissen 1954) for further details). In the present study, see table 5, scrapers are by far the largest tool category.

Out of the 1351 artefacts in total in the extant collection, 1169 artefacts are not retouched at all, while 79 artefacts feature some kind of retouch. It was not possible to identify a specific pattern of/preference for retouch, but semi-abrupt, convex, parallel direct retouch is the most commonly appearing (Inizan et al. 1992:67; 76; 85; 91; 94). Normal and scraper retouch also occur to some extent. On the majority of modified artefact, continuous parallel retouch is found on one dorsal edge towards the distal end. In a few cases, artefacts were partially retouched on parts of the ventral edge. The frequent occurrence of parallel retouch is consistent with the amount of scrapers found in the assemblage.

Scrapers

Several previously unaccounted for tools were identified, most of which were various types of scrapers (see figures 33 and 34). Most scrapers are thumb sized and similar to *Wehlen* type scrapers known from the original publication (Rust 1958:44); (Schwabedissen 1954). Most scrapers in the original publication were almost completely retouched (Rust 1958:44; fig. 13). The picture gained from the present study is less clear, while many thoroughly retouched scrapers were re-analysed, just as many are only retouched to a small degree, mostly at the distal end (see e.g. figures 33 and 34). Type and degree of retouch could not be correlated to the artefact's size.

The longest complete scraper measures 67 mm/39 mm (ID-2012 1273), while scrapers on average reach minimum lengths of 30 mm and minimum widths of 15 mm. Among the combined artefacts, the longest scraper on blade measures 72 mm and 18 mm (ID-2012 1315). The dimensions of this scraper are only approximate values, because only the medial part of the artefact is preserved. The longest scraper on a crested blade (Rust 1958: *Tafel* 13.18), measures 76 mm and 33 mm (ID-2012 69). It is almost twice as large as the other scrapers,

Figure 11: Assorted scrapers from Borneck-Ost. Photograph by Mara-Julia Weber.

completely preserved and a singular appearance at Borneck-Ost. A similar combined artefact is scraper `1156`, made on a plunging core rejuvenation blade (see figure 34). Scrapers appear to have been fabricated on all types of suitable blanks, ranging from initial flakes (see also Rust 1958: *Tafel* 13.4; 13.16) to core rejuvenation flakes and blades.

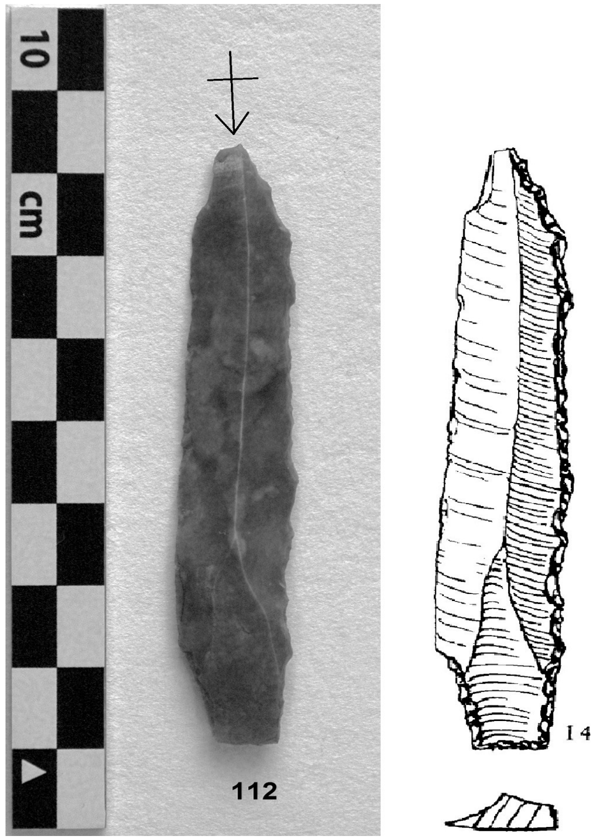
Burins

In the original publication, burins also figure as a significant artefact category. Unfortunately, most of the previously published burins are now missing from the extant collection (see table 3). However, two previously unaccounted for burins were identified, see artefacts `1087` and `163` in figures 35 and 36. Both burins are combined artefacts; `1087`, a flake with a thick, cortex-covered proximal end and bulbus intact, is thoroughly retouched with parallel, direct convex retouch along the right dorsal edge, similar to the retouch seen on some of the scrapers. The burin spall was struck from the distal end onto the left dorsal edge. On the other burin, `163`, the proximal end is absent, so the original length of the blade is not preserved. The artefact is a burin on a blade with oblique retouched truncation.

Backed blades/the Federmesser

The previously mentioned period diagnostic type artefact, the *Federmesser*/curved back blade (see figure 2), could not be identified. The "best candidate" from Borneck-Ost (ID-2012 `112` and Rust 1958: *Tafel* 14.14), measures 72 mm and 12 mm, but only the medial part is preserved. Almost all edges are thoroughly retouched, and the basal end is the business

Figure 12: Modified artefact/*Federmesser* from Borneck-Ost, photograph (left) by Mara-Julia Weber, drawing (right) after Rust 1958: *Tafel* 14.14.



end. Two blades with oblique retouched truncation (*Schrägendklinge*) could perhaps be classified as *Federmesser*. This problem requires further attention. A recurring observation is that the *Federmesser*-like blades were retouched just as frequently at the base as they were at the apex. In these cases, the proximal end was altered or altogether removed through extensive retouch. No preference for basal or distal retouch could be identified.

6.3 Summary

In this chapter, the lithic assemblage from Borneck-Ost has been analysed with a main focus on technological aspects. The aims has been to gather further information regarding the individual technical traits of the artefacts, in order to determine whether or not the material from Borneck-Ost is disturbed or homogeneous. This will be used as a base for the interpretation of the site.

A total of 1351 artefacts was catalogued, which exceeds the totals reached in the original publication by almost 400 artefacts. The totals reached for different debitage product categories in the previous and present study do not match each other entirely, but differences in nomenclature and shifts in lithic analysis tradition can help explain the discrepancies.

On the basis of these shared knapping attributes, it can be concluded that the lithic assemblage indeed is homogeneous and undisturbed. The present study has not been incriminated through neither post-depositional processes nor the previous analysis (Rust 1958). Blade production on locally available raw materials took place at Borneck-Ost. Both hard and soft hammer technique was used, which is in accordance with observations from other Federmesser sites. No concrete evidence can be gained from the tools (3.51%) found on the site; only one curved backed blade was identified, and the classification of this as a typologically distinct *Federmesser* is subject for discussion. Therefore, the importance of technological attributes cannot be stressed enough, since these allow for the use and analysis of the site regardless of the uncertainty concerning its typological designation.

Some questions, like the significant difference in total sums of artefacts in the two studies, require further attention. It cannot with certainty be determined whether the lithic material undoubtedly can be classified as Federmesser. In any case, the results from the re-analysis show that blade production took place on site, using both hard and soft hammer technique.

CHAPTER 7

Results from refitting

The technological analysis has brought forth evidence which suggests that the extant collection from Borneck-Ost is a homogeneous lithic assemblage. Through the method of refitting artefacts, which is an integral part of the *chaîne opératoire* approach, the completeness of the collection as well as the spatial distribution of artefacts will be tested further. Other examples can be found in e.g., (Bodu, Karlin and Ploux 1990); (Cziesla 1986); (Cziesla et al. 1990); (Bodu 2007); (Schurmans and De Bie 2007); (Weber 2012); (Skar and Coulson 1986); (Cahen and Keeley 1980).

7.1 Parameters of refitting

Borneck-Ost was neither dug in different strata, sieved, nor is the artefact distribution within the quadrants specified. Therefore it is not possible to produce a high-resolution spatial analysis, which could identify different activity zones on site (c.f. (Audouze and Enloe 1997)). Still, even though the *ideal* conditions are not given, refitting is still essential when analysing a potentially mixed and disturbed assemblage. It has been argued that refitting is especially usable for investigating short-term camps because the course of movement on site has not been as disturbed by activity as is the case for dwellings (Clausen and Hartz 1988:23-24). During the preparation of the catalogue of the extant collection, all artefacts were initially laid out according to quadrants. By way of trial, subjectively matching artefacts (e.g. in terms of similar colour or raw material) were refitted, as had been proposed by (Cziesla 1986:252).

A total of 29 refit groups were possible. Most refit groups are composed of two refits (19 in total) or three artefacts (6 in total). Some artefacts may break due to natural processes and refits of this kind are therefore not included in the analysis (Cziesla 1986:254). While it unfortunately was not possible to refit the extant collection to a greater extent, the available refit groups still provide vital information regarding the operational scheme. Also, some uncertainty regarding artefact distribution was investigated and clarified. With one exception, only refit groups of more than three conjoined artefacts will be presented in depth (cf. (Weber 2012:247 pp)).

The refit groups strengthen the impression received through the technological analysis – that the material from Borneck-Ost, is indeed from the same context.

7.2 Distribution of refit groups

The distribution of refit groups refutes some of Rust's arguments; for instance, the lower half of the site was previously considered to be sterile (Rust 1958:44). As can be seen in figure 13, some artefacts attributed to quadrants on the lower half were found to refit with artefacts found upper half of the site. Also, row "P" had previously not been considered to be part of the spatial extent of the Federmesser group site, instead, as was presented earlier (see figure 3), the original excavator had claimed it to belong to a *Callenhardt-Gruppe* camp (Rust 1958:57). The characteristics of this group are unknown. Not only does the site extend beyond the distribution pattern brought forth in the original documentation, but refits of material attributed to this speculative *Callenhardt-Gruppe* onto Federmesser-material, strengthens criticism and scepticism (as voiced by (Tromnau 1975) among others) against the actual existence of this alleged typological group.

7.3 Refit groups

In the following pages, selected refit groups will be presented in order of their importance. Aspects which were confirmed and illustrated through refitting, are:

- Distribution of corresponding artefacts on site/homogeneity of assemblage
- Confirmation of rows P and Q belonging to the Federmesser-associated assemblage (thereby contradicting Rust 1958 and the presence of the alleged *Callenhardt-Gruppe*)
- Production on site
- A range of knapping attributes (e.g. core preparation, core correction)

Refit group 1

`ID-2012: 1007, 1242, 1291, 1295, 1293, 1297` (quadrants N120, P114, P119). Refit group 1 (see figure 14) consists of six artefacts and it illustrates both blade production on site, as well as it answers questions concerning spatial distribution. All artefacts are curved, which is typical for core preparation (as stated by (Weber 2012:247)). The raw material is fine-grained, grey opaque flint.

As can be seen in figure 14, all artefacts within this refit group are covered in cortex to a large extent. The refit group represents core preparation through cortex removal, and it also offers an example for blade production on site. Although the core preparation blades are far from being thin, straight and slender, the small proximal ends of the artefacts serves as an indication of what products could be obtained from this core. Some of the blades were prepared prior to the blow, whereas others were knapped from an unprepared platform and with a hard hammer stone. *Also, this artefact distribution is of special interest, as it confirms that row P is part of the Federmesser use of the site.*

Refit group 2

`ID-2012: 74, 1351, 1352, 1353, 1354` (quadrants: K118, L117). Refit group 2 consists of a core with four refits (see figure 30 for an illustration of the core), which is another important evidence for production on site. Natural inclusions in the core illustrate why the production sequence was interrupted at an early stage. Most refits onto the core contain a significant amount of cortex, signalling cortex removal as well as preparation of the core into the desired shape and volume. Some step breaks occur; these are directly caused by the natural condition of the nodule. The core as such was knapped from two opposite directions, and platform preparation is seen at both ends. Due to the inclusions in the core, it is unsure whether the core was knapped from both sides intentionally, or if the side was changed because of unsuccessful knapping attempts. Although one of the earliest removals hinged and exposed the poor raw material quality, the nodule was worked a bit more.

Refit group 3

`ID-2012: 9,10,910,762` (quadrants: H122, M120, M122). Refit group 3 is comprised of four artefacts and measures 54 mm in height and 37 mm in width. These dimensions are only approximates, since the refitted artefacts are partly fragmented and have been altered through heat. The artefacts are spread across three quadrants. The fairly square, yet curved flakes indicate platform rejuvenation. Platform rejuvenation flakes are typically curved, as was previously seen in refit group 1 as well. This platform rejuvenation happened at a later stage in the production sequence, because only one artefact (no. `10`) is covered in any cortex at all (less than a third cortex dorsally). Since not all flakes belonging to this refit group are present, no definite conclusion regarding the core's platform size can be drawn, but it points towards a large and thick platform, providing a large striking angle. The *esquillements de bulbe* seen on the artefacts' ventral surface are a defining element of soft stone percussion during knapping (see also chapter 2.3), and thus provide vital information regarding knapping attributes applied on the site.

Refit group 4

`ID-2012: 996, 1210, 1211` (quadrants N120, O119, P119) Refit group 4 is made up of three artefacts (see figure 15). It represents both blade production as well as correction of a knapping error. It measures approximately 70 mm/33 mm and is knapped in a light grey, fine grained flint with leopard-pattern otherwise not found at Borneck-Ost. Long, slender blades with a tapered end of similar dimensions were the desired end products. The negative dorsal scars on the refit group show that step breaks were recurring knapping errors, threatening to ruin the core. These errors were corrected through the large blade removal (artefact 996). While the middle blade's platform is meticulously prepared and features no ventral scars at the proximal end, the error correcting blade was not prepared to a similar extent, yet it corrects the recurring step breaks and cleans the face of the core (Clausen and Hartz 1988:25).

This refit group is interesting in the same way as i s refit group 1, because it also shows that row P can be attributed to the Federmesser part of the site, not the *Callenhardt*-group camp, as was initially suggested by Rust (1958:57). The refit group also illustrates that core correction, i.e. blade production, took place on site.

Refit group 5

`ID: core 490 and flakes 452, 453` (quadrant L121) Refit group 5 consists of three artefacts, one core and two flakes (see figure 8 for details). This refit group is an additional illustration of core correction, as well as of production on site. The core, which can be seen in figure 25, can be characterised as exhausted because all negative dorsal removals show how knapping attempts continuously resulted in step breaks. The two hinged flakes fit onto each other, as well as onto the core. They are knapped from the lower platform, and can be interpreted as correcting flakes, which, unfortunately, hinged as well, contribute towards the abandonment of the core.

Refit group 6

`ID-2012: 1171, 1173, 1174` (quadrant O119). This refit group, see figure 16, is an additional example for production on site, and more importantly, the presence of *esquillement de bulbe* shows that soft stone technique was used directly on the site.

7.4 Summary

Results from refitting have contributed to a better understanding of Borneck-Ost. Blade production using soft hammer technique took place on the site, and refit groups include examples for core preparation and repair at various stages of the knapping process. Additionally, the distribution of refit groups shows that the site has a slightly different extension than what had been suggested (Rust 1958:61). The lower half of the site is not sterile, as had been argued before, and refits between the lower and upper half of the site show that these two halves are connected (Rust 1958:60). Row P can now definitely be considered a part of the Federmesser assemblage. Also, as can be seen from several examples of refit groups where conjoined artefacts are from the same quadrant, the site has not been taphonomically disturbed in a way that caused artefacts to travel far across the site. There are no indications towards a problem of co-occurrence, c.f. (Soressi and Geneste 2011:340-341).

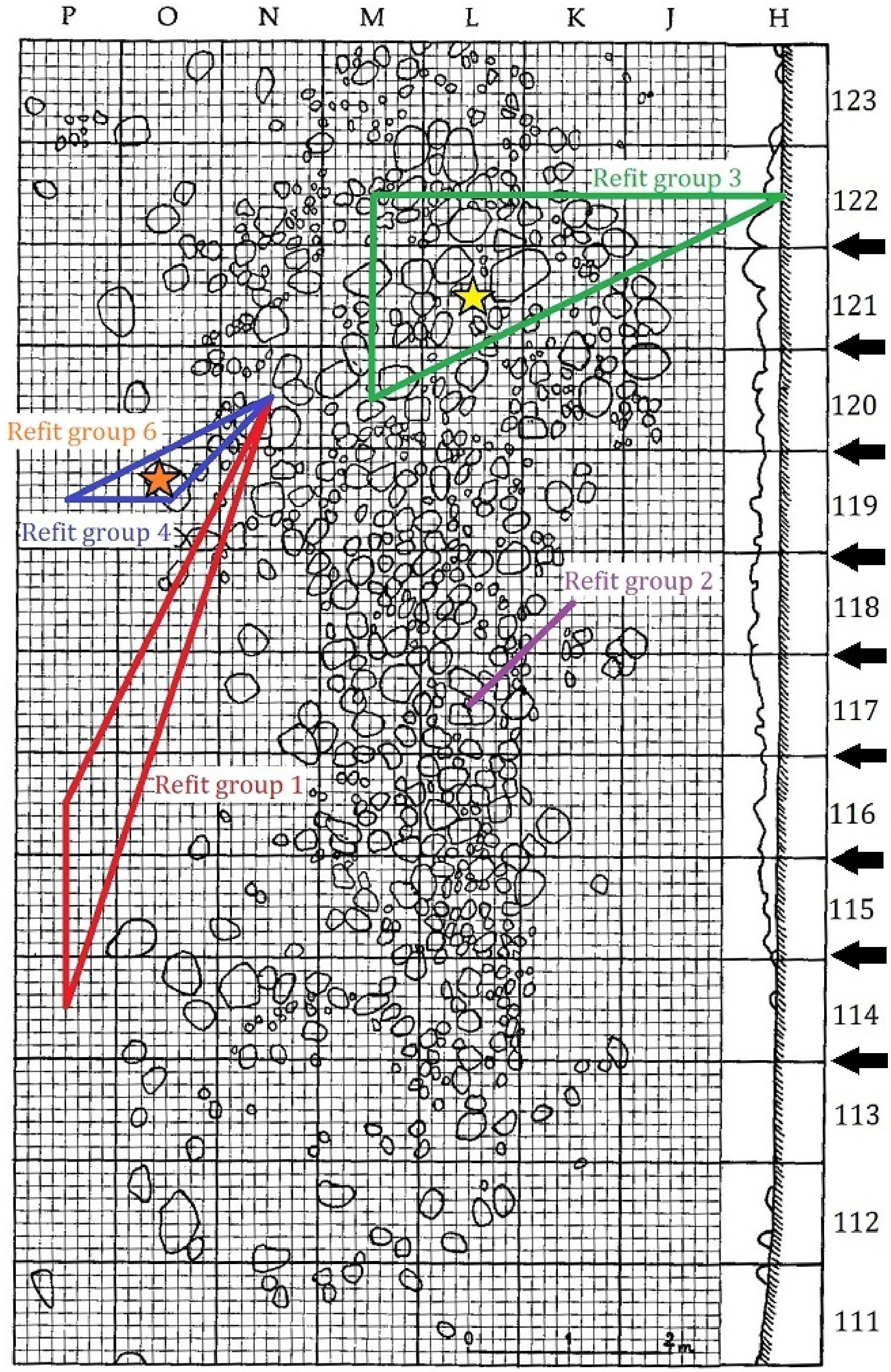


Figure 13: Distribution of refit groups at Borneck-Ost. Yellow star marks placement of refit group 5, black arrows represent the direction in which melting water ran across the site (after Rust 1958:52, fig. 15).

Figure 14: Details from refit group 1 from Borneck-Ost. Objects not to scale, approximately 2:3. Photograph by author.

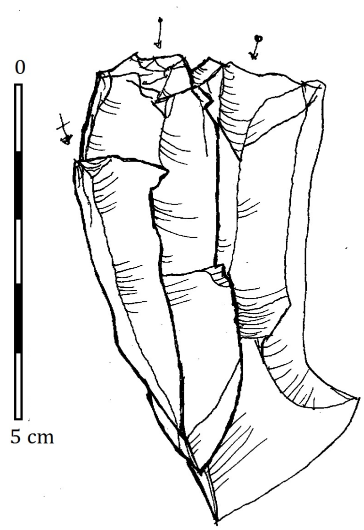


Figure 15: Refit group 6 from Borneck-Ost, including artefacts 996, 1210, 1211. Drawing by author.

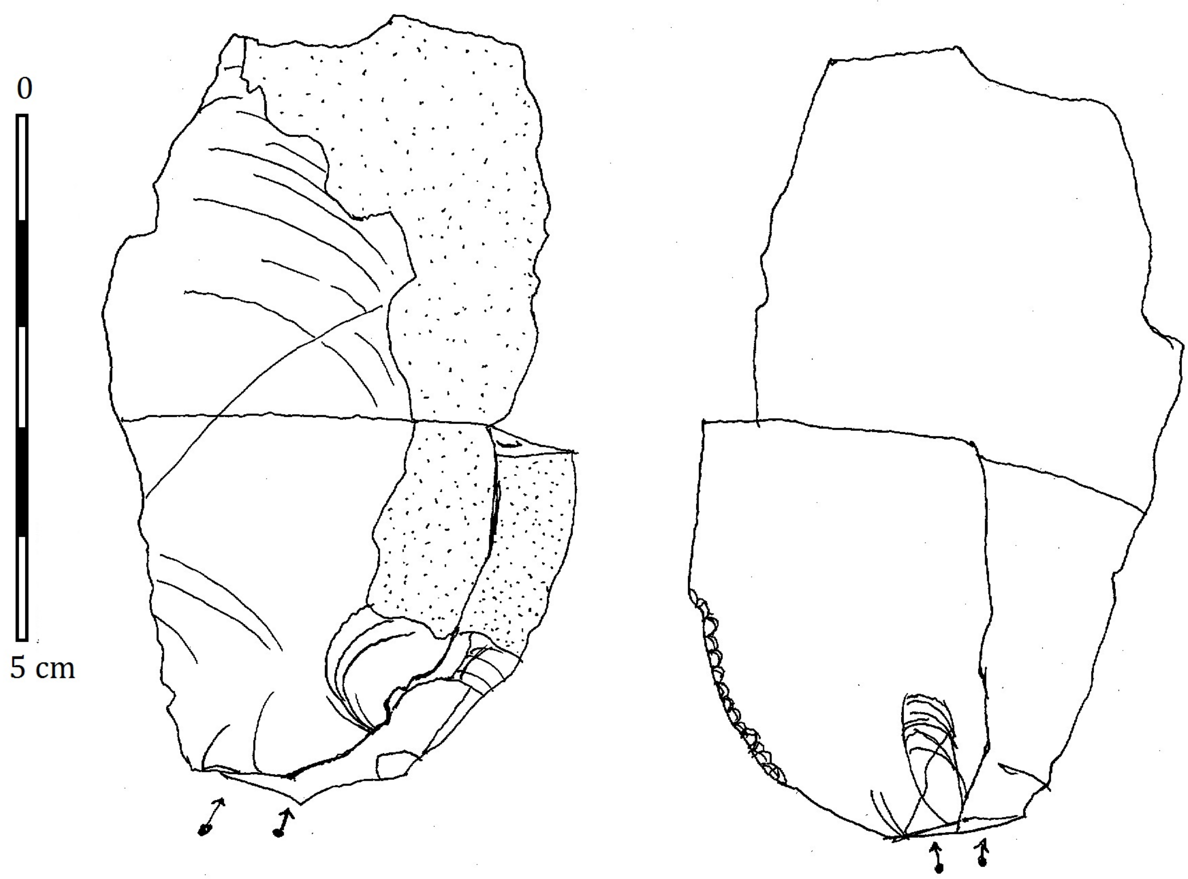


Figure 16: Refit group from Borneck-Ost, including artefacts 1171, 1173, 1174. Drawing by author.

CHAPTER 8

Results

Borneck-Ost has been re-approached through a set of methods. First, as a preparation of the present study, the previously available information from the original excavation and publication, was presented. The site and material were then submitted to a renewed study using a *chaîne opératoire* approach. This serves as a foundation for the technological re-analysis and my interpretation of the results.

Different aspects of the site and lithic assemblage were studied individually. While this separation is necessary, it is nevertheless artificial, since site and material record are invariably linked and interact with each other. They must be seen in combination in order to form a complete impression of Borneck-Ost. In the following, the results of the analyses will be presented.

8.1 Reinterpretation of Borneck-Ost: what was there, really?

> *"Mais, d'autre part, il faut reconnaître qu'il est difficile de trouver une autre explication pour des pierres situées à ces endroits par l'homme [. . .]."*
>
> –*(Fosse 1973:11)*

With regard to the information available through the original publication, it has been found that all in all, while some aspects and interpretations have to be rejected, the present study enables us to come to *almost* the same conclusions: the remains of a Federmesser tent were excavated at Borneck-Ost. On what grounds? And, more importantly, is the spectacularly shaped tent now based on a solid analytical foundation in its suggested size and layout?

Figure 17: Schematic reconstruction of the Magdalenian tent at Borneck-Ost (Rust 1958:58, fig. 18).

According to the original publication (Rust 1958), the stone structure could be separated into an upper (larger) and a lower (smaller) tent ring, which are connected through a stone paved hallway. All structures were covered in hide and together form the distinct double-tent/"spectacle shaped" tent which has been criticised repeatedly over the past decades (see figure 17). The upper, larger tent served as the habitation, while the lower, smaller tent served as storage. This original interpretation was strengthened by the concentration of artefacts as well as evidence for a hearth/fireplace in the middle of the largest tent. In the original publication, eight of the ten quadrants containing most artefacts can be attributed to what has been interpreted as the largest tent. In general, artefacts were recovered from the upper half of the site (see figure 18a), further supporting evidence for a focus of activity there.

The general pattern of distribution according to the present study (see figure 7b) is only moderately changed compared to the previous artefact distribution (see figure 7a), despite the significant differences in the total sum of artefacts. What is cause for differences in the two catalogues (see table 2 and table 5), is, regrettably, not determinable – although all elements of uncertainty been taken properly care of over the course of this study. Also, the quadrants most rich in finds are still the same as they were, even though the total amount of artefacts in those quadrants is slightly changed. Unfortunately, since the site was not dug in different strata, it cannot be determined if artefacts originally were concentrated in the same context and represent a single occupation event (Rensink 2012:259).

Concerning the prominent stone structure, it has not been possible to determine to what extent it is caused by natural processes; but, as is illustrated by (Fosse 1973) in the aforementioned quote, what other compelling arguments are there against an anthropogenic structure? The results from the present study in parts confirm Rust's original interpretation, although it has not been found that the tent can be maintained in its distinct shape. Tent stakes and guy ropes may have been attached to the stone structure, similar to Sami examples, see e.g. (Fosse 1973:11). Artefact distribution at Borneck-Ost is consistent with a focus of activity on the upper half of the site, and artefacts are more evenly distributed across the stone structure. Quadrants with most artefacts correspond to the suggested upper tent ring, as well as to the suggested walkway. Through the technological analysis it has become evident that blade production took place on the site, and modified tools were apparently brought onto the site, and possibly also replenished there.

It has been suggested by Rust (1958:47-52) that the tent was built on the stone structure in order to protect its occupants from a freezing cold ground during winter and from melting water in spring. The upper tent served as the habitation, the other parts as storage and transit. Because of the effort one went to in order to build the stone structure, this must necessarily have been a semi-permanent construction, for particular use during winter. The original excavator argues for a repeated use of the site over a substantial, very season-specific amount of time (Rust 1958:55-58). *Can this interpretation be maintained?* Taken the results from the technological analysis as well as from refitting into account, the amount of artefacts is unconvincing for a repeated use of the site. The extent of the lithic assemblage is more corresponding to a short-term use of the site, without possibilities to determine at what time of the year. Admittedly, the soil was not sifted, so presumably some amount of material (mostly debris) has never been recovered, but it is speculative to make assumptions as to how much this changes, since even small, e.g. fingernail sized artefacts were excavated and catalogued for the present study. It is instead far more probable that Borneck-Ost represents a short-term camp where some blade production took place.

What can also be said now is that Rust's argumentation (1958:61) for a separate group (*Callenhardt-Gruppe*) which camped next to the remains of the Federmesser site (rows P and Q), can no longer be maintained for several reasons. First of all, there is no formal evidence available in the research canon for the existence of this typological group. There are no known identifiable characteristics or traits or differences which could enable one to separate between Federmesser and *Callenhardt-Gruppen* material. It is most likely a relict of the time when every new facet of late-glacial artefacts was attributed to a new typological group. Second of all, and of more specific significance for Borneck-Ost, some refits confirm that rows P and Q indeed belong to the Borneck-Ost site (see figures 10 and 13).

8.2 Results from the technological analysis

The interpretation of the technological analysis is less straightforward. As was mentioned earlier (see chapter 2.3), there is no detailed description of Federmesser knapping techniques available for northern Germany (Weber 2012:88). All indications thus far point toward a very varied spectre of techniques, e.g. the use of both soft and hard hammer. Especially because there is still some uncertainty regarding the relationship between the Hamburgian Havelte group phase and the Federmesser (Holm 1996:48; 51), a conclusive set of references for the area would be greatly helpful. On the basis of the attribute analysis of all available artefacts from Borneck-Ost, I have decided to retain the classification of the material as **Federmesser**.

Certain diagnostic features for other late-glacial archaeological groups were *not* encountered during the present technological analysis, like for example no platform preparation *en éperon*, or *Zinken* or *Riesenklingen*. Ambiguous artefacts were compared directly with corresponding artefacts from other periods. Upon direct comparison, artefacts in question were found to be too Federmesser to be something else. For example, core 24, which "wouldn't be suspicious in a Hamburgian context" (Hartz, Weber pers.comm. 2012), differed significantly from Hamburgian cores in platform angles and knapping technique by close comparison.

The majority of artefacts represent the early stages of production and the *chaîne opératoire*. All stages of blade production were identified. A small percentage of artefacts was modified into tools, mainly scrapers. For what purpose, we do not know. We cannot, by any means, determine the idea and thoughts behind why these and those blanks were selected for use, and what greater scheme led them to make these decision. We can only describe what we see, and discuss it within certain parameters.

A general impression is that cores were made from a range of locally available material, ranging from two palm-sized flint slabs to substantially larger nodules. For direct comparisons, please see figures 20 to 32 in the appendix. No preference for any particular shape, quality or size of the nodules could be identified. It remains unknown to what extent the nodules were covered in cortex, and if nodules were smooth or uneven, which of course influences the amount of cortex preserved on flakes as well as the effort it takes to achieve the desired core; see e.g. (Madsen 1992:118).

Conceptual scheme: identifying individual knappers Cores generally display a high level of technological knowledge, since long and slender blades were successfully knapped, despite the mediocre/not-optimal local raw material quality. If the soft hammer and hard hammer products were knapped by different individuals cannot be determined on the basis of the extant collection.

Even the technological analysis of a relatively small assemblage like Borneck-Ost can render information regarding individual knappers: A few of the cores show the signature of an additional contributor. Some of the exhausted cores (e.g. see figure 22) were picked up after discard, and attentively knapped further. This can be seen in core preparation, which mimics/is similar to the core preparation on the other cores. However, the knapping attempts following this second use of the core, remain unsuccessful. Instead of blanks or tools, only more step breaks were produced. An experienced knapper could anticipate this, and therefore abandoned the cores originally. The additional knapper appears to lack this kind of knowledge, while simultaneously displaying an understanding for the necessary production steps and techniques, see e.g. (Ingold 1990:8). "A gap between aim and realisation" between the different knappers indicates different individual skill levels (Hodder 1990:155); see also (Högberg 1999), (Högberg 2008); (Sternke and Sørensen 2009:722); (Finlay 1997); (Lillehammer 2010); (Cahen and Keeley 1980); (Skar and Coulson 1986:97-99); (Bodu, Karlin and Ploux 1990:152); (Shea 2006:215); (Grimm 2000:54); (Gamble 1998:439-440); (Karlin, Pigeot and Ploux 1992:1108, 1111); (Moore and Scott 1997); (Inizan, Roche and Tixier 1992:23;25).

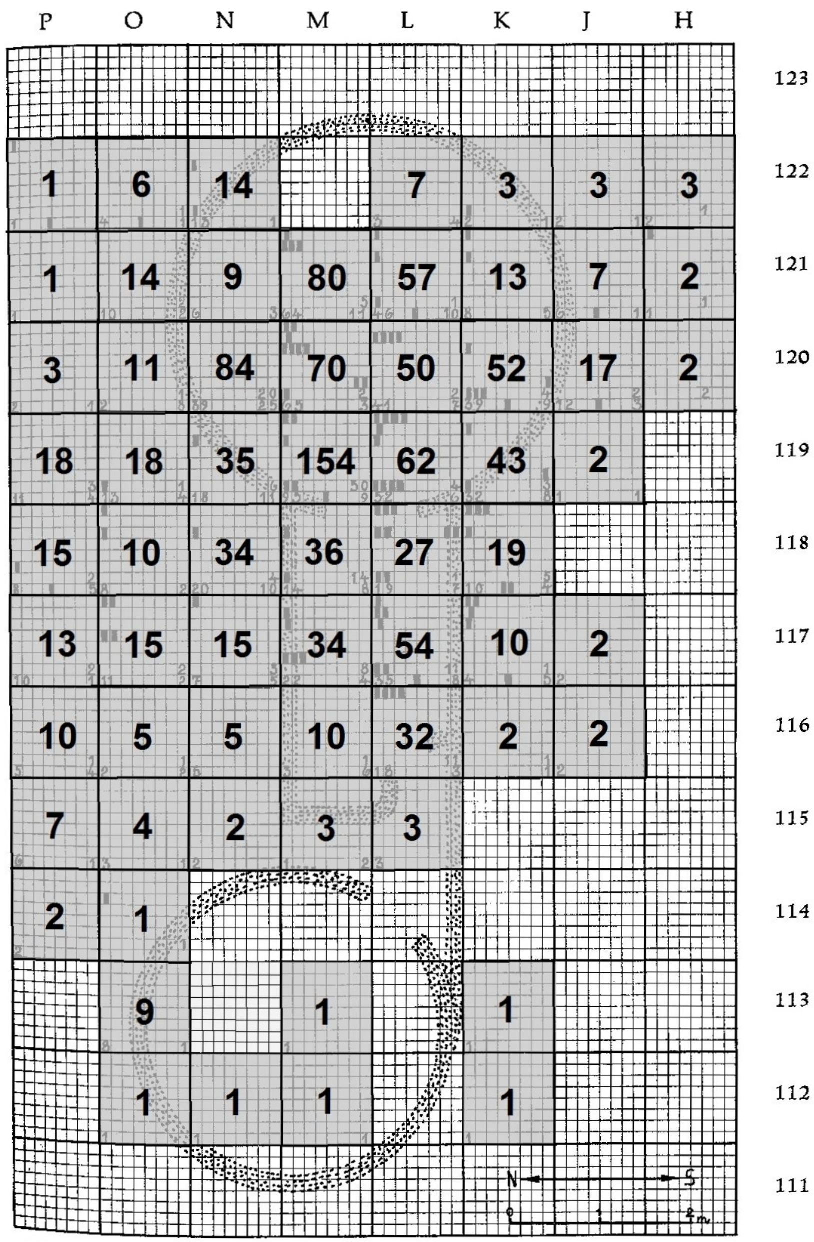
8.3 Concluding remarks

This source-critical, technological re-analysis of Borneck-Ost does not present a radical new interpretation of neither the site nor the original publication. Many of the existing interpretations are reconfirmed through the extensive attribute analysis of the extant collection, and results are strengthened and supplied through refitting. While some original interpretations could be refuted through the re-analysis, these have not had a substantial impact for the general interpretation of the site. No dramatical differences in artefact distribution or composition of the lithic assemblage could be exposed. Instead, the presence of a tent at Borneck-Ost is highly likely, although it cannot be maintained in its infamous shape. Also, the classification of the site as Federmesser could be carefully confirmed as of the current state of knowledge. The relatively small assemblage even allows for the identification of multiple individuals who took part in the blade production on the site.

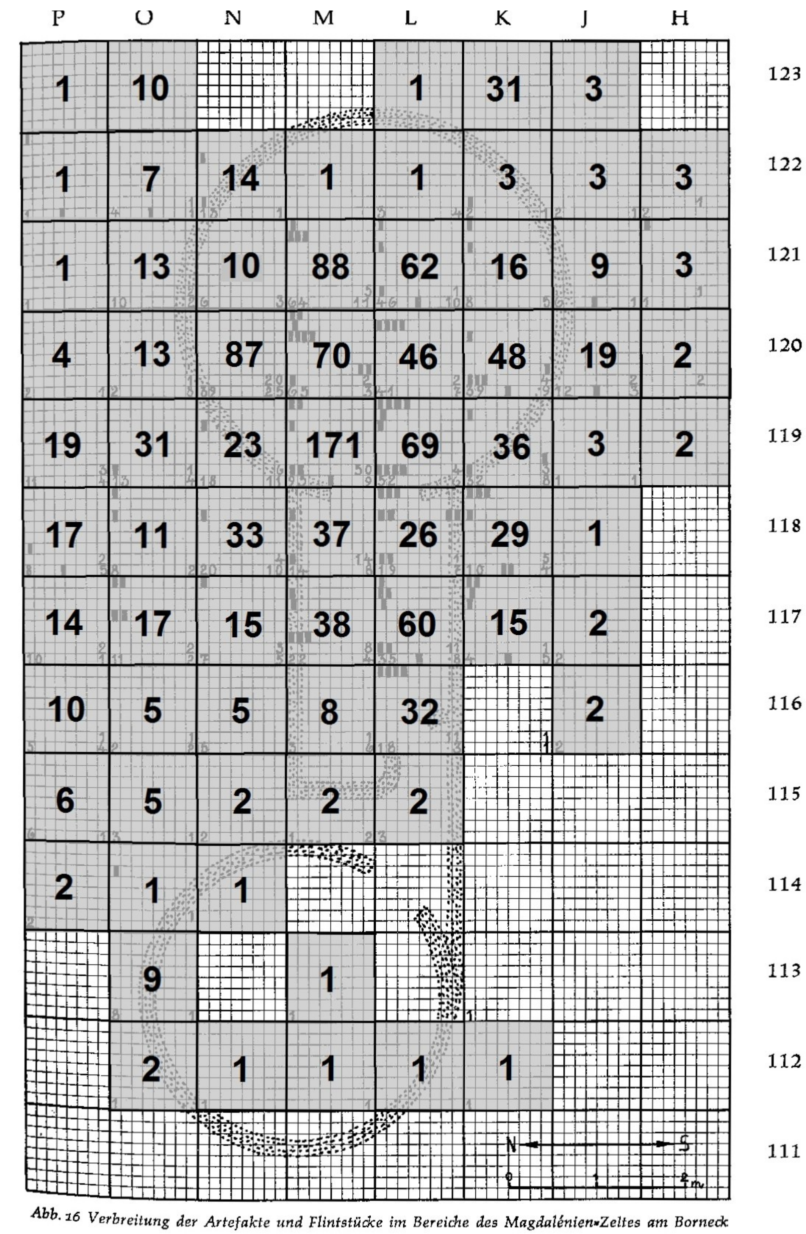
It be could argued that the present study has not fulfilled its purpose; Rust was right, and the tent is still standing. Still, the re-analysis has showed that an extant, typologically analysed collection which has never before been approached with a lithic technological focus, can be re-investigated several decades after, and yet yield new results, for the site specifically and the Federmesser in general. The fact that most of the original interpretation could be confirmed, indicates that earlier research often is reliable according to modern archaeological practice. This should be seen as a motivation for future re-analyses of extant collections. An source-critical evaluation of the available information is, of course, crucial — but, extant collections should be nevertheless be considered as a resource.

APPENDIX A

Detailed artefact distribution

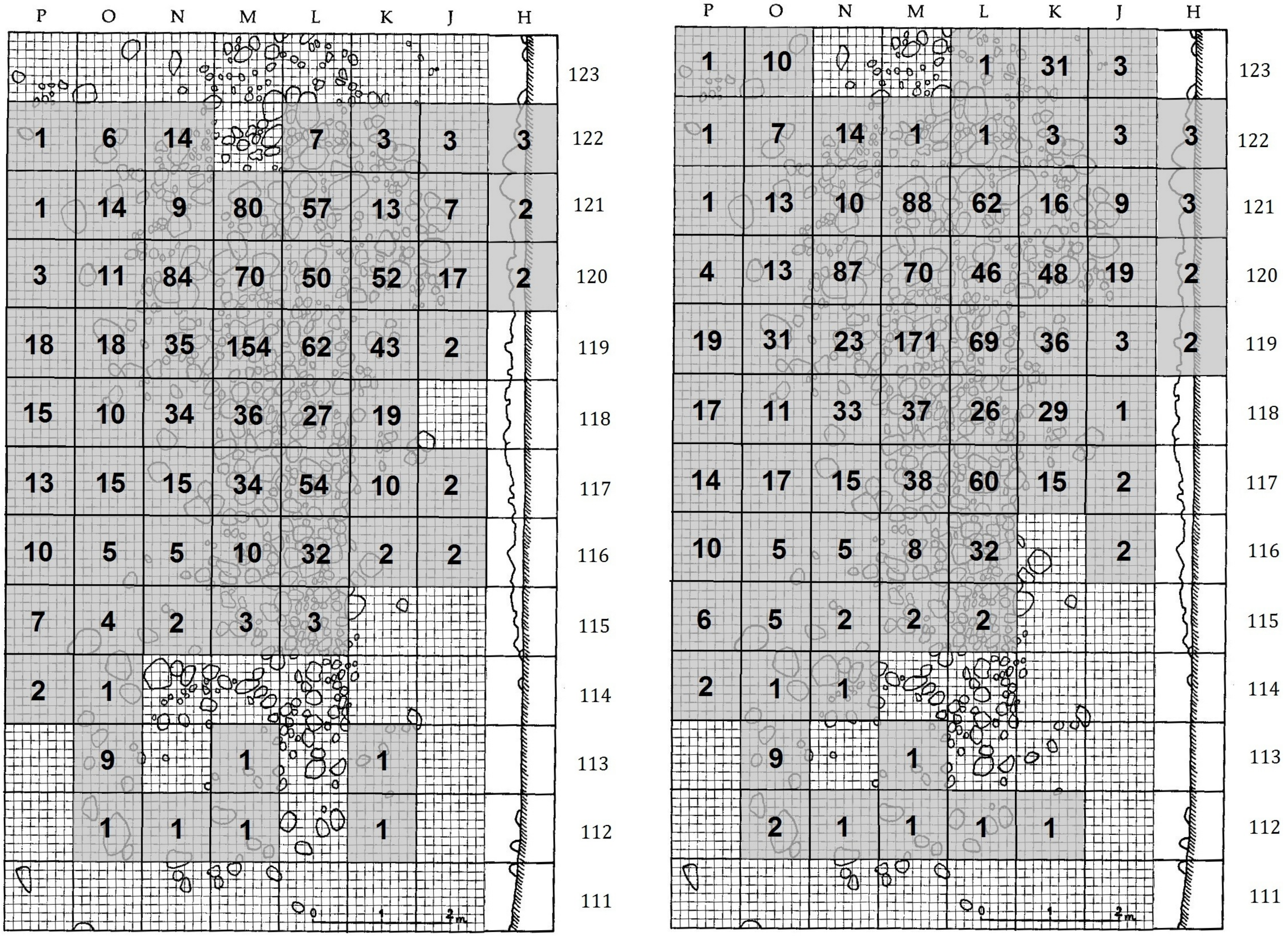


(a) Distribution according to Rust 1958:53, fig. 16).



(b) Distribution according to present study.

Figure 18: Distribution patterns of artefacts from Borneck-Ost (after Rust 1958:53, fig. 16).



(a) Distribution according to Rust 1958:44-45

(b) Distribution according to present study

Figure 19: Distribution patterns of artefacts from Borneck-Ost in relation to the stone structure (after Rust 1958:52, fig. 15).

APPENDIX B

Knapping attributes

Table 11: Curvature of all artefacts based on present author's personal observation (n = 1332).

Curvature	Count	Percentage
Curved	824	61.86
Straight	508	38.14

Table 12: Size of striking platform; general overview (Sørensen 2006:27, fig. F).

n = 669	Flakes	Flakes (%)	Blades	Blades (%)
Broad	118	17.64	50	7.47
Broad, narrow	65	9.72	18	2.69
Broken	28	4.19	28	4.19
Heat damage	4	0.60	–	–
Large	85	12.71	40	5.98
Point	53	7.92	25	3.74
Small	105	15.70	43	6.43
Small, narrow	4	0.60	3	0.45
Total	**462**	**69.06**	**207**	**30.94**

Table 13: Shape of striking platforms and occurrence in all flakes and blades, (n = 739) (according to Sørensen 2006:27, fig. F).

Shape	Flakes	Flakes (%)	Blades	Blades (%)
Broad	1	0.14	–	–
Broad, cone	1	0.14	–	–
Broad, narrow	2	0.27	–	–
Broad, two facets	1	0.14	–	–
Large, faceted	–	–	1	0.14
Large, irregular	2	0.27	–	–
Oval	54	7.31	46	6.22
Point	55	7.44	19	2.57
Rectangular	152	20.57	51	6.90
Removed, trimmed to shape	–	–	1	0.14
Round	3	0.41	3	0.41
Shattered	1	0.14	–	–
Small	3	0.41	–	–
Small, irregular	1	0.14	–	–
Small, narrow	3	0.41	1	0.14
Square	54	7.31	15	2.03
Triangular	72	9.74	41	5.55
Broken	8	1.08	9	1.22
Heat damage	27	3.65	3	0.41
Irregular	76	10.28	33	4.47
Total	**516**	**69.82**	**223**	**30.18**

Table 14: Platform composition ($n = 600$)(according to Sørensen 2006:28, fig. G).

Type	**Flakes**	**Flakes (%)**	**Blades**	**Blades (%)**
Cortex	22	3.67	–	–
Faceted	154	25.67	77	12.83
Irregular	1	0.17	2	0.33
Shattered	2	0.33	–	–
Smooth	195	32.50	95	15.83
Two facets	35	5.83	16	2.67
Quartz	1	0.17	–	–
Total	**410**	**68.33**	**190**	**31.67**

Table 15: Types and frequency of platform preparation at Borneck-Ost, general overview. ($n = 757$) (according to Madsen 1992:105, fig. 70 F).

Type	**Flakes**	**Flakes (%)**	**Blades**	**Blades (%)**
Dorsal trimming, remaining platform intact	24	3.17	4	0.53
Dorsal abrasion	–	–	1	0.13
Dorsal and on platform	1	0.13	1	0.13
Dorsal trimming and on platform	1	0.13	–	–
Heat damage	5	0.66	–	–
Isolated dorsal trimming	74	9.78	36	4.76
Large dorsal and platform trimming	2	0.26	1	0.13
Large dorsal trimming	155	20.48	61	8.06
Large dorsal trimming and striking platform	1	0.13	–	–
On striking platform	57	7.53	23	3.04
Platform partially rounded by abrasion	–	–	1	0.13
Platform rounded by abrasion	26	3.43	19	2.51
Small dorsal trimming	90	11.89	73	9.64
Small dorsal and on platform	1	0.13	–	–
Trimmed on platform	2	0.26	–	–
Unprepared	64	8.45	13	1.72
Unprepared on cortex	15	1.98	6	0.79
Total	**518**	**68.43**	**239**	**31.57**

Table 16: Types and occurrence of lips on artefacts from Borneck-Ost ($n = 1279$). Categories include combined artefacts (Sørensen 2006:27, fig. D).

Type	**Flakes**	**Flakes (%)**	**Blades**	**Blades (%)**
None	677	52.93	298	23.30
Lip	83	6.49	44	3.44
Pronounced lip	133	10.40	44	3.44
Total	**893**	**69.82**	**386**	**30.18**

Table 17: Condition of proximal end (n = 862) (according to Sørensen 2006; Pelegrin 2000:79).

Condition	**Flakes**	**Flakes (%)**	**Blades**	**Blades (%)**
Bulb	128	14.85	52	6.03
Bulb; accident siret	1	0.12	–	–
Bulbs; bulb scar	–	–	1	0.12
Bulb; bulb scar	87	10.09	51	5.92
Bulb; bulb scars	2	0.23	–	–
Bulb; bulb scar; lip	1	0.12	–	–
Bulb scar	24	2.78	107	12.41
Bulb scars	3	0.35	–	–
Bulb scar; lip	1	0.12	–	–
Bulb; bulbar scale	11	1.28	1	0.12
Bulb; heat damage	1	0.12	–	–
Bulb; lip	1	0.12	1	0.12
Bulb; pronounced lip	1	0.12	–	–
Bulbar scale	13	1.51	22	2.55
Bulbar scales	2	0.23	2	0.23
Bulbar scale; heat damage	–	–	2	0.23
Bulbar scale; two bulbs	–	–	2	0.23
Esquillement de bulbe	105	12.18	27	3.13
Esquillement de bulbe; bulbar scale	2	0.23	–	–
Esquillement de bulbe; cortex	1	0.12	–	–
Esquillement de bulbe; heat damage	2	0.23	–	–
Esquillement de bulbe; two bulbs	1	0.12	–	–
Four bulbs; bulb scar	1	0.12	–	–
Heat damage	14	1.62	1	0.12
Lip	1	0.12	–	–
No bulb	16	1.86	7	0.81
Pelegrin 2000:79,b	23	2.67	19	2.20
Pelegrin 2000:79,d	1	0.12	–	–
Pelegrin 2000:79,e	10	1.16	2	0.23
Pelegrin 2000:79,f	1	0.12	1	0.12
Pronounced bulb	20	2.32	3	0.35
Pronounced bulb; bulb scar	4	0.46	–	–
Pronounced lip	1	0.12	–	–
Small bulb	29	3.36	25	2.90
Small bulb; bulb scar	2	0.23	–	–
Two bulbs	7	0.81	4	0.46
Two bulbs; bulb scar	9	1.04	2	0.23
Two bulbs; bulb scars	1	0.12	–	–
Two bulbs; *esquillement de bulbe*	1	0.12	–	–
Three bulbs	1	0.12	–	–
Pronounced bulb; *esquillement de bulbe*	–	–	1	0.12
Total	**529**	**61.37**	**333**	**38.63**

Table 18: Frequency and occurrence of cones on all flakes and blades, ($n = 491$), as observed by present author.

Cone: placement; number	**Flakes**	**Flakes (%)**	**Blades**	**Blades (%)**
On platform	14	2.85	5	1.02
Two cones on platform	5	1.02	2	0.41
On ventral	151	30.75	76	15.48
Pronounced cone on ventral	8	1.63	3	0.61
Two cones on ventral	13	2.65	4	0.81
On platform and ventral	104	21.18	48	9.78
Pronounced cone on platform and ventral	1	0.20	–	–
Two cones on platform and ventral	42	8.55	9	1.83
Three cones on platform and ventral	3	0.61	2	0.41
Five cones on platform and ventral	1	0.20	–	–
Total	**342**	**69.65**	**149**	**30.35**

Table 19: Type and occurrence of knapping errors on all artefacts from Borneck-Ost ($n = 366$).

Type of knapping error	**Flakes**	**Flakes (%)**	**Blades**	**Blades (%)**
Bulb on distal end	1	0.27	1	0.27
Hinge on distal end	88	24.04	39	10.66
Hinge; ripples on ventral surface	76	20.77	34	9.29
Ripples on ventral surface	76	20.77	34	9.29
Step on dorsal surface	1	0.27	–	–
Step on ventral surface	13	3.55	1	0.27
Steps on dorsal surface	1	0.27	–	–
Thick ripple on ventral surface	1	0.27	–	–
Total	**257**	**70.22**	**109**	**29.78**

APPENDIX C

Illustrations

Unless otherwise specified, all illustrated artefacts are from Borneck-Ost and were drawn by the present author.

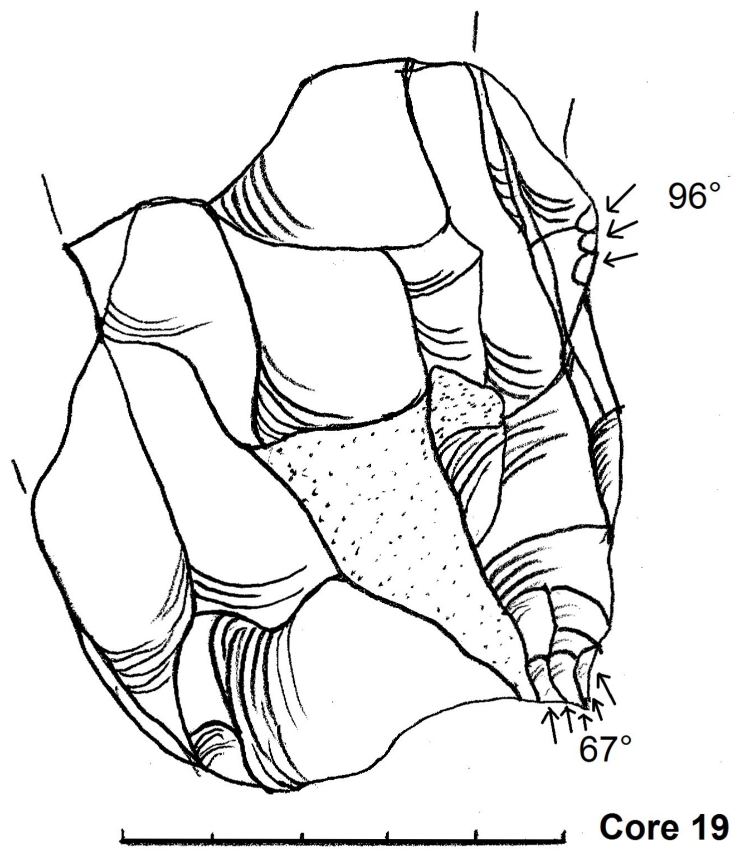


Figure 20: Core 19

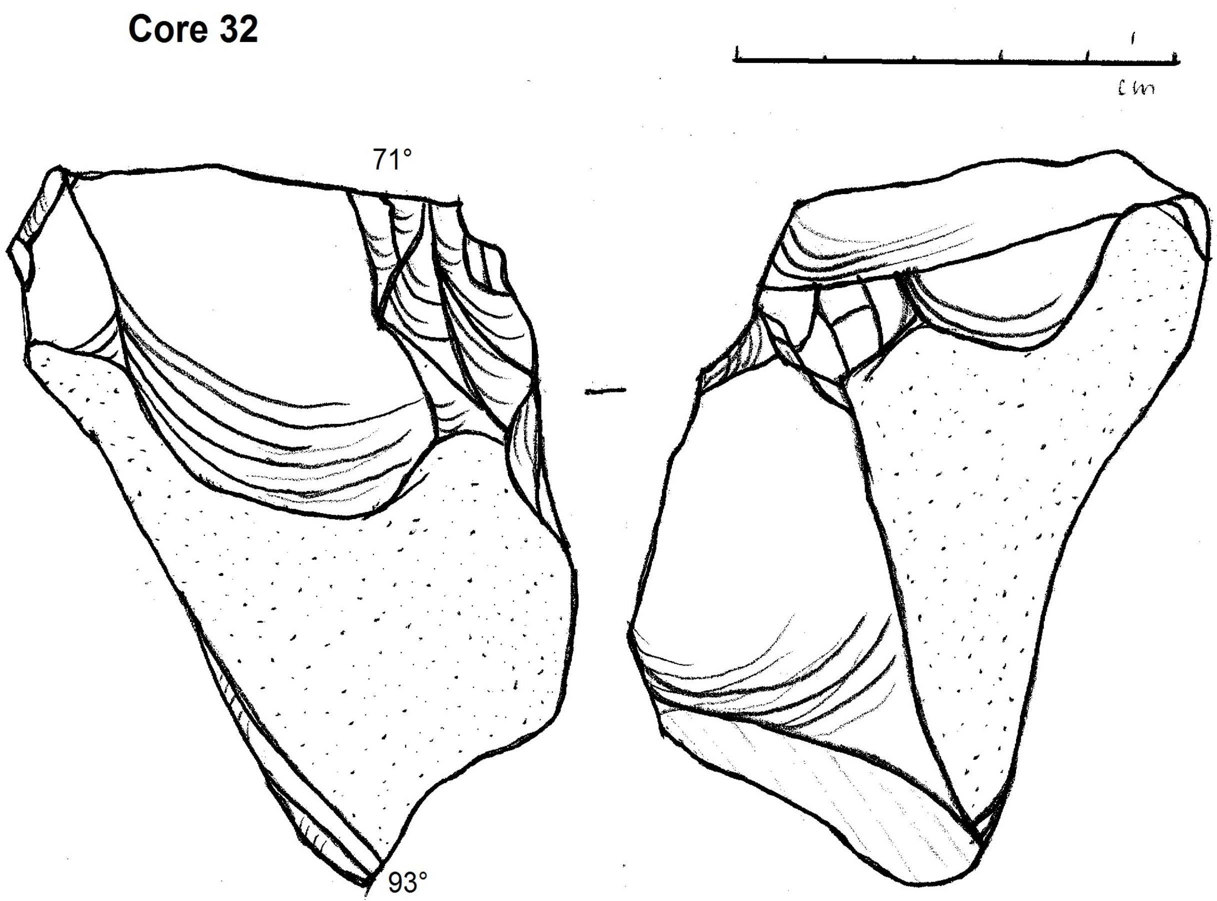


Figure 21: Core 32

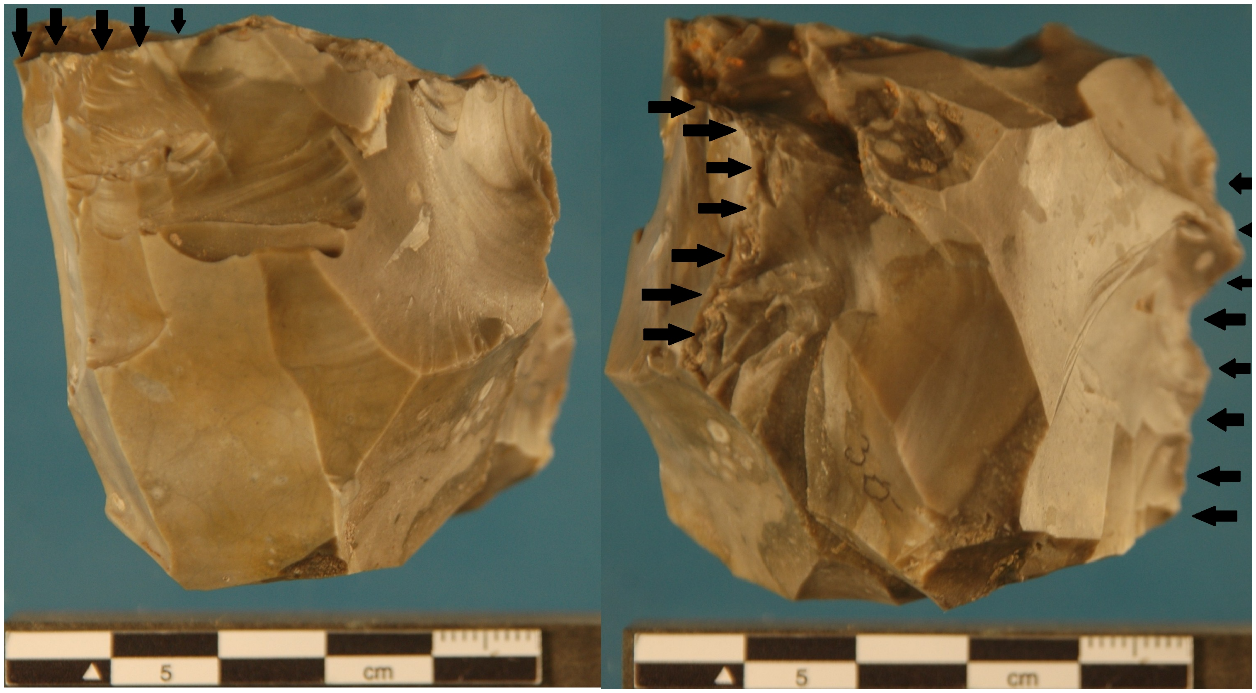


Figure 22: Core 53, front and back. Photograph by author.

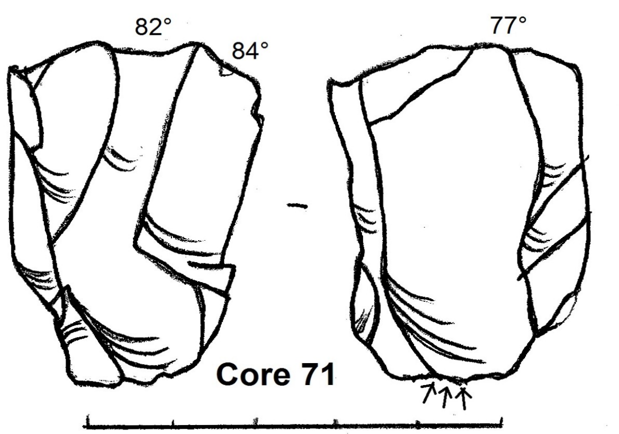


Figure 23: Core 71

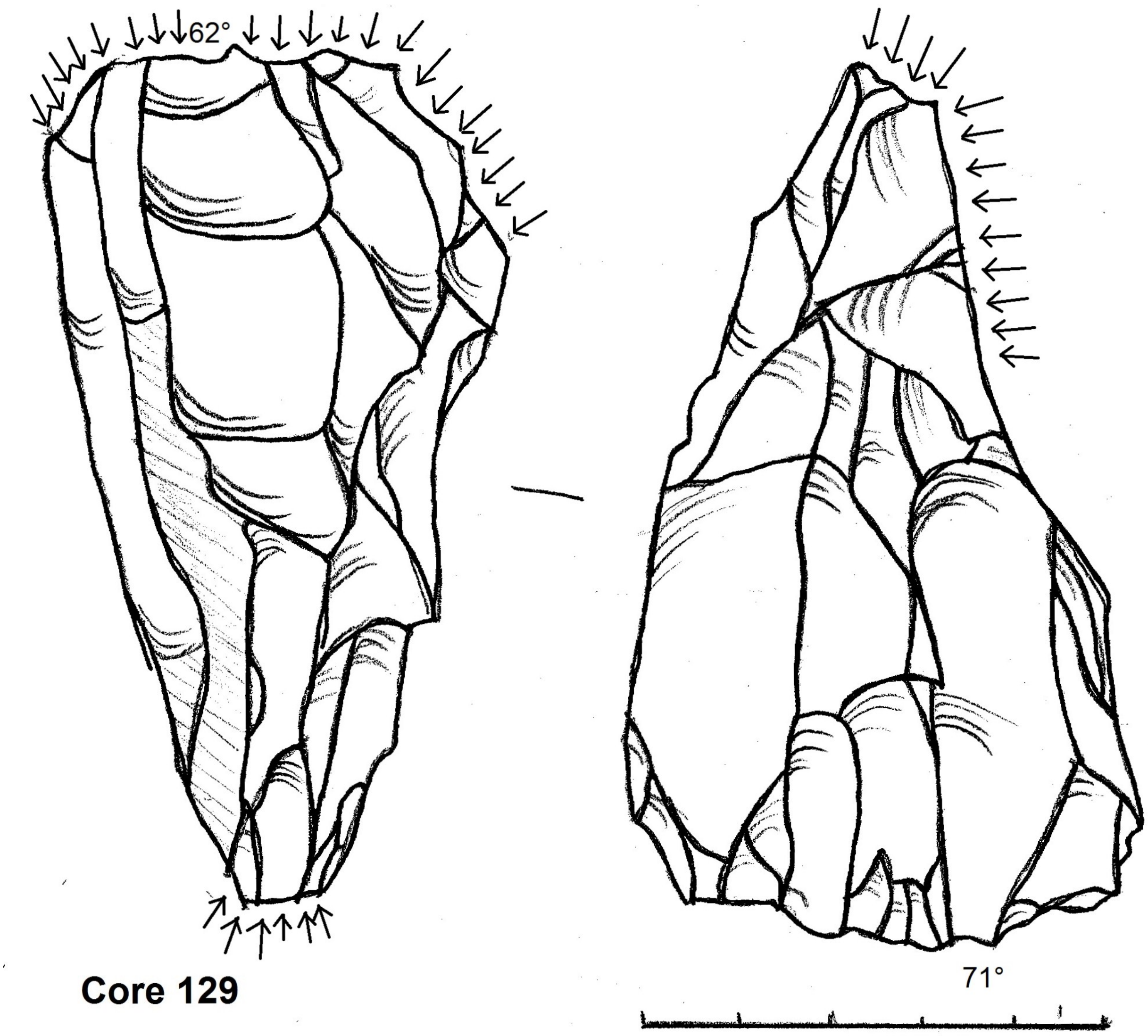


Figure 24: Core 129

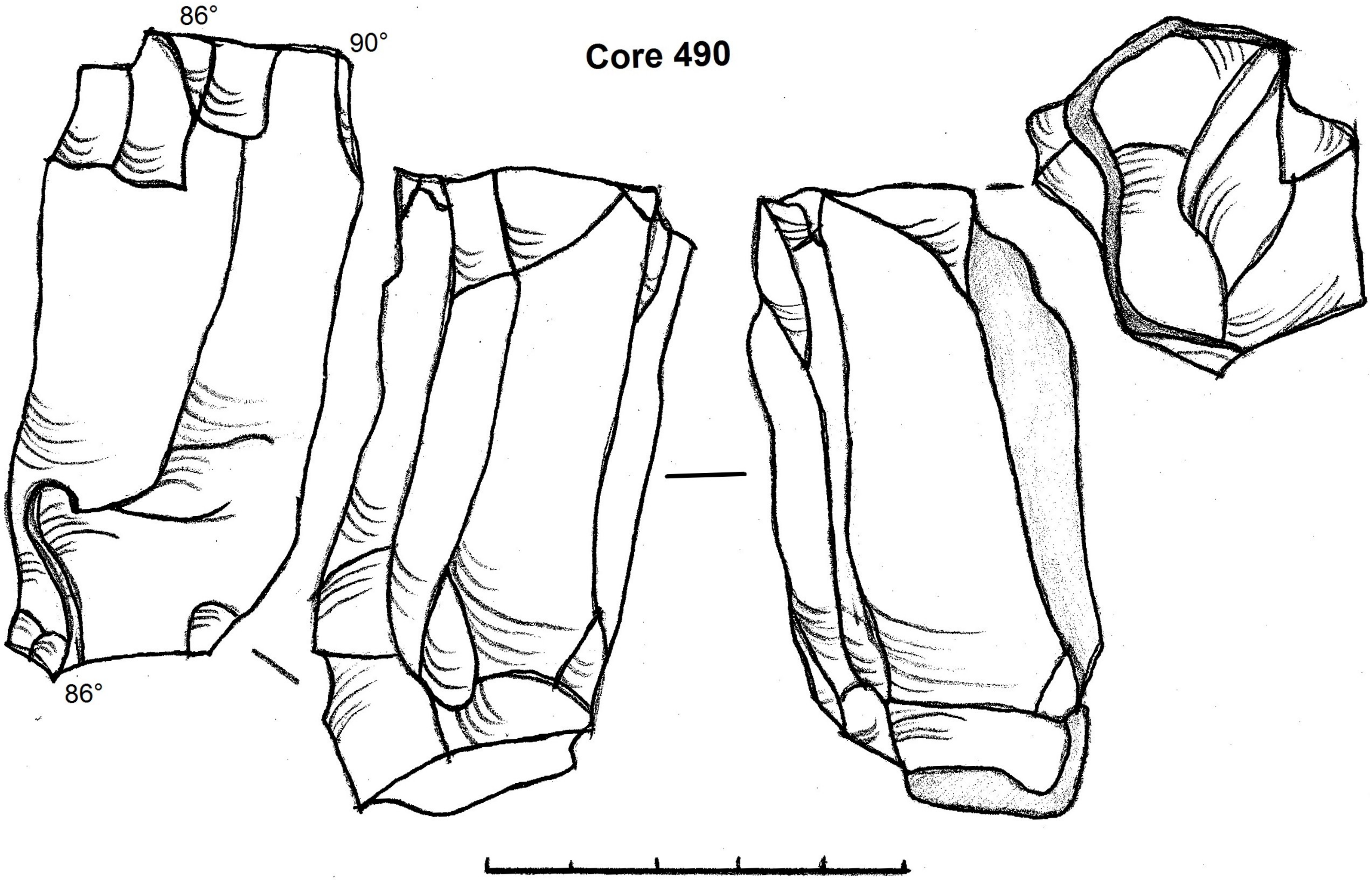


Figure 25: Core 490

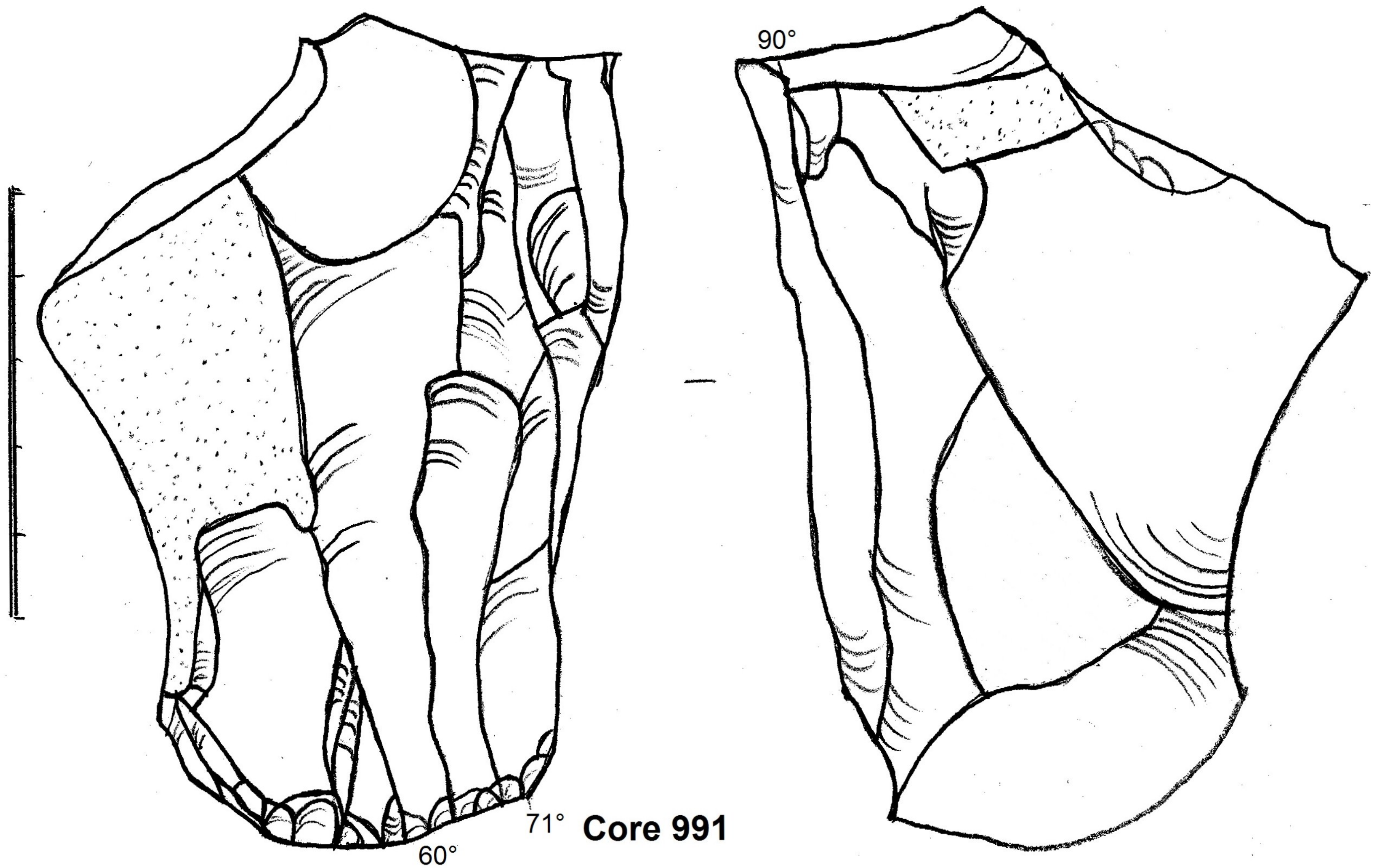


Figure 26: Core 991

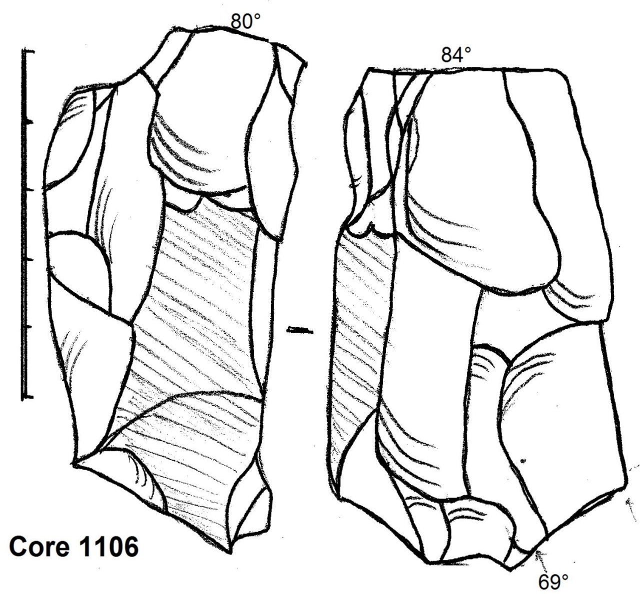


Figure 27: Core 1106

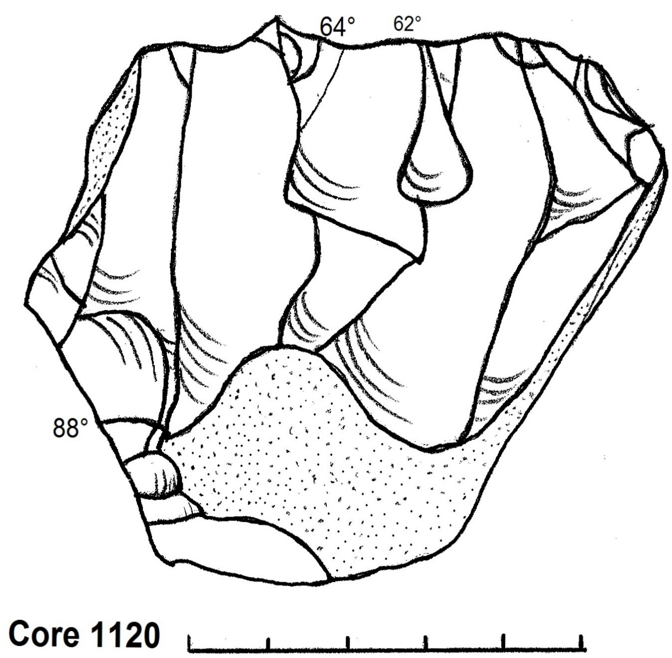


Figure 28: Core 1120

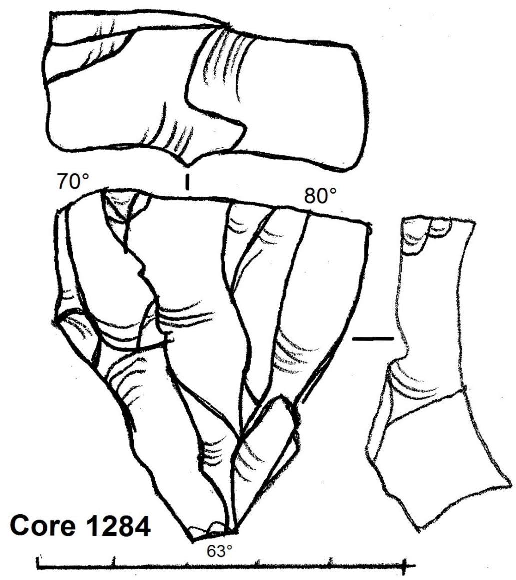


Figure 29: Core 1284

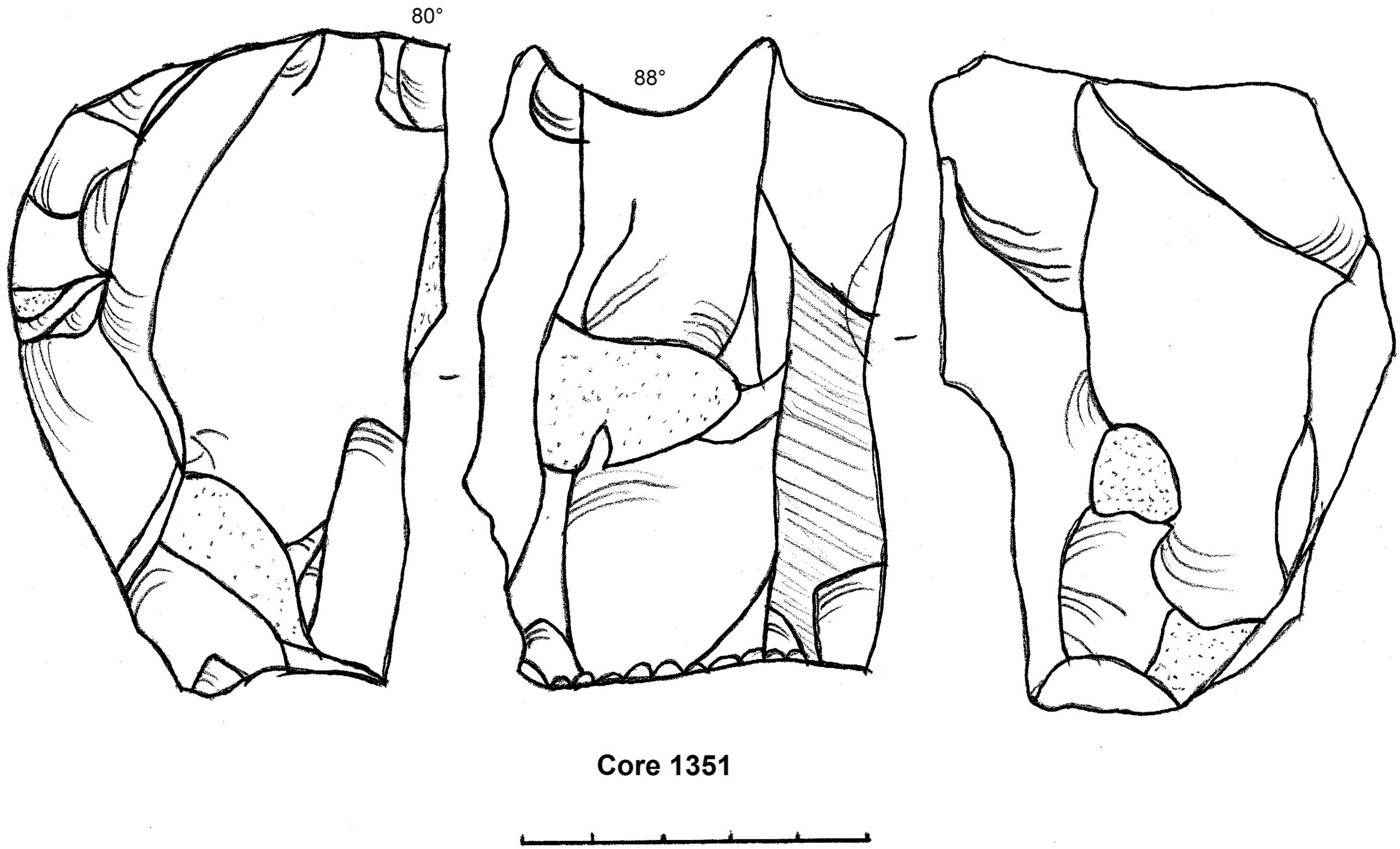


Figure 30: Core 1351

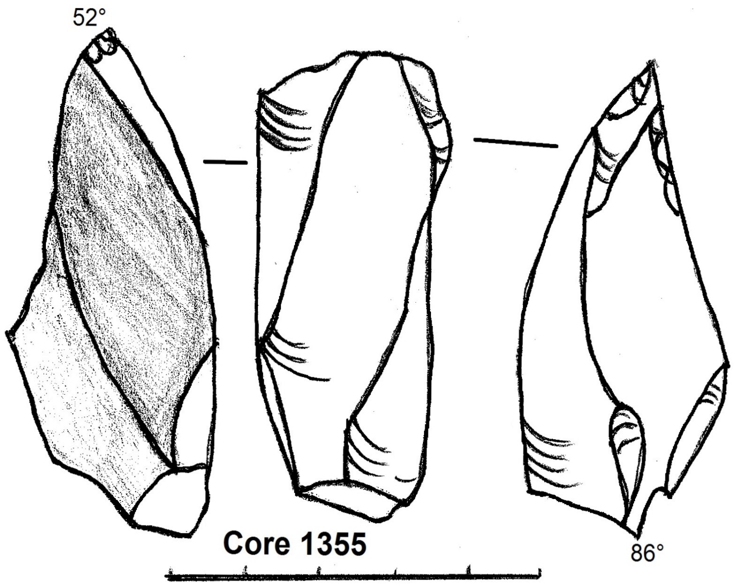


Figure 31: Core 1355

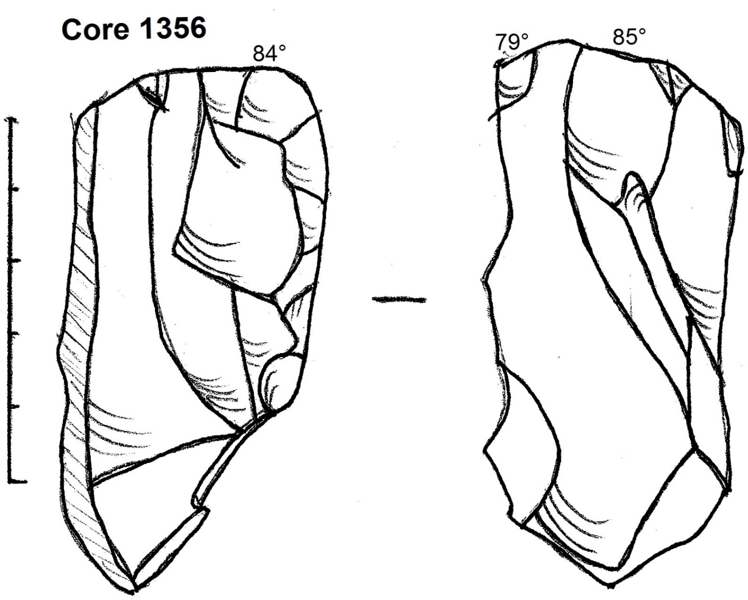


Figure 32: Core 1356

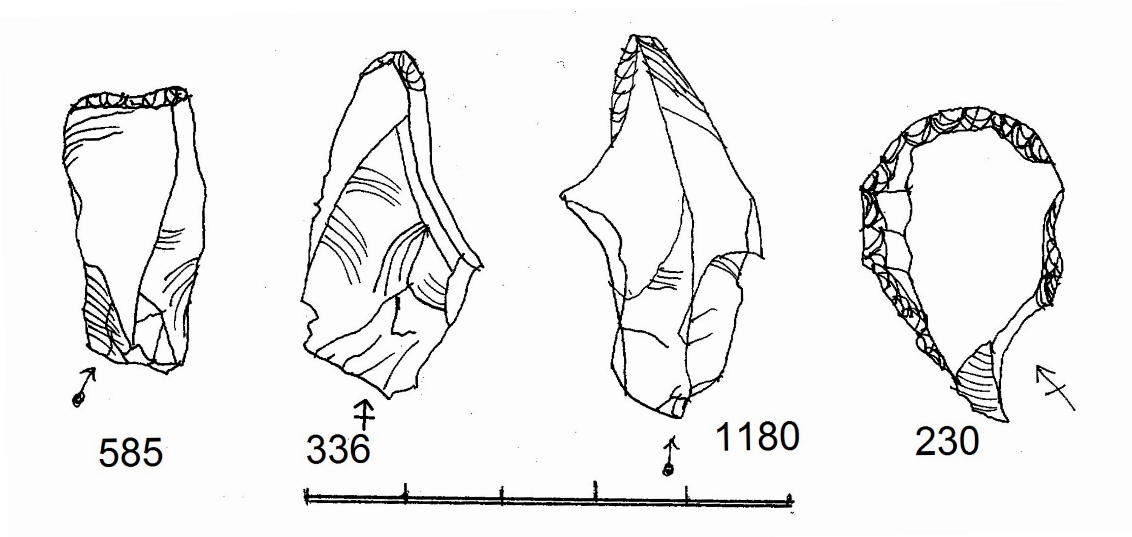


Figure 33: Unpublished assorted short scraper types from Borneck-Ost. Drawing by author.

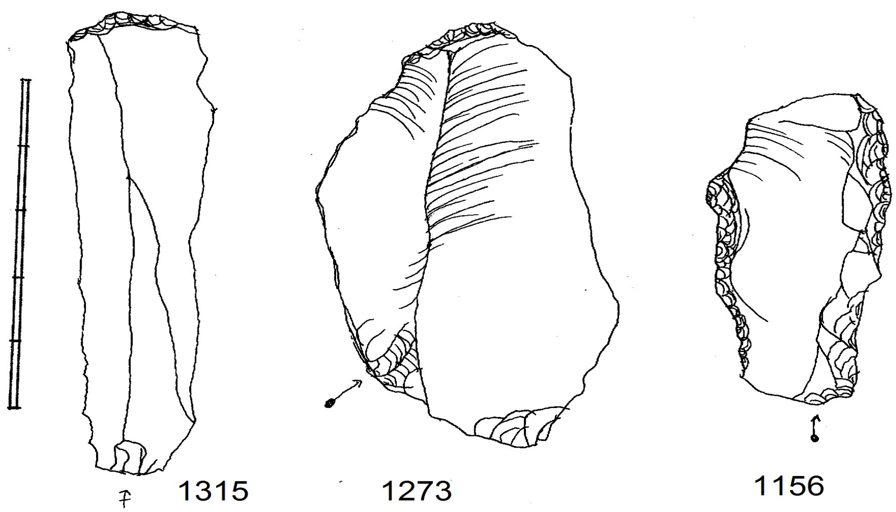


Figure 34: Unpublished assorted long scraper types from Borneck-Ost. Drawing by author.

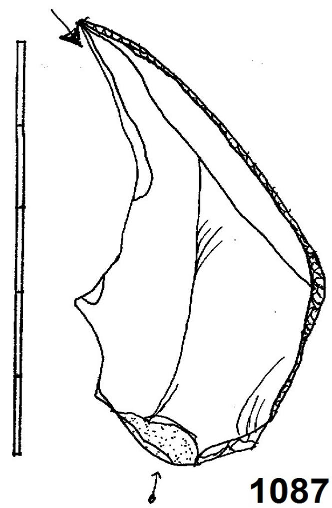


Figure 35: Unpublished burin from Borneck-Ost. Drawing by author.

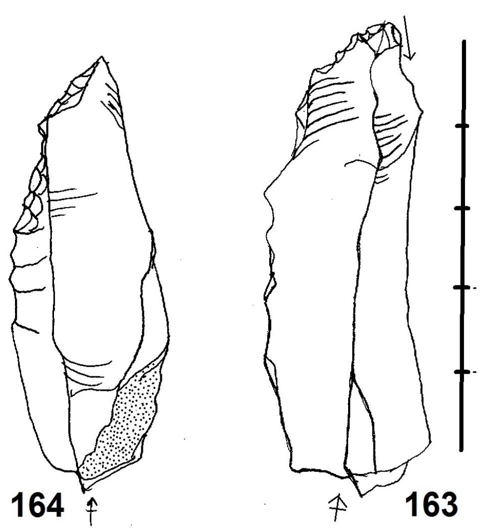


Figure 36: *Federmesser*-like blade and burin from Borneck-Ost. Drawing by author.

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